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PERSONAL LIBERTY.

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IN dealing with many of the questions which come within the domain of the student of political economy or of social science it becomes expedient to refer to the decisions of the courts, especially among the English-speaking people. The paramount question at issue to-day is the maintenance of personal liberty. The precepts upon which personal liberty rest have become incorporated in the common law, and when personal rights are impaired by statute law the complainant may appeal to the courts and may establish his own control over all the factors that are necessary or conducive to his support as a matter of right, so long as he does not infringe the equal rights of others. Among such factors is the right to control one's own time.

One of the most profound changes which has occurred in the relations of men to each other has been the change from status to contract. In ancient days, under ancient law, the place which a man could hold in society was fixed by the condition of his birth, by his relation to his father, his family, or his gens or his class. His individuality was absolutely subordinate to the condition in which he had been born. From the dawn of history contract may have been found in existence, but its fulfillment depended upon its form rather than upon any moral engagement. Sir Henry Maine observes that "the conception" (of contract) "when it first shows itself is rudimentary. No trustworthy primitive record can be read without perceiving that the habit of mind which induces us to make good a promise is as yet imperfectly developed, and that acts of flagrant perfidy are often mentioned without blame, and sometimes described with approbation. In the Homeric literature the deceitful cunning of Ulysses appears

as a virtue of the same rank with the prudence of Nestor, the constancy of Hector, and the gallantry of Achilles."

Elsewhere, Sir Henry Maine, when dealing with the progress of a society resting upon the just relations established by free contract, remarks that "the many have an almost instinctive reluctance to admitting good faith and trust in our fellows as more widely diffused than of old. . . . From time to time these prepossessions are greatly strengthened by the spectacle of frauds unheard of before the period at which they are observed."

"But," as he most profoundly remarks, "the very character of these frauds shows clearly that, before they became possible, the moral obligations of which they are the breach must have been more than proportionately developed. It is the confidence reposed in and deserved by the many which affords facilities for the bad faith of the few; so that, if colossal examples of dishonesty occur, there is no surer conclusion than that scrupulous honesty is displayed in the average of the transactions which, in the particular case, have supplied the delinquent with his opportunity."

In the observations of nearly half a century of business life the writer has become profoundly impressed with the truth of these observations, and has been almost brought to the conclusion that contracts would be fulfilled, commerce would go on, and debts would be paid as fully in the long-settled and well-established communities now existing in many parts of this country, if all laws for the collection of debts and all acts of legal tender were repealed.

When the quality of the money of a nation is evenly maintained, no act of legal tender is needed to enforce its acceptance by a creditor. If there is any other point of dispute, evidence of an offer of the debtor to fulfill his contract in money might be perpetuated without giving him an option to pay in poorer money than he had promised. It is only when the quality of money has been depreciated that an act of legal tender is cited by a debtor, and in so doing he transfers the fraud from his own shoulders to the Government that has impaired the terms of his contract.

In the free states which have been established by the English-speaking people character stands for more than capital in establishing credit; credit rests more upon the high standard of business integrity than upon legal provisions for the collection of debts: under these conditions, freedom on the part of the purchaser and the seller, the employer and the employed, to make just contracts, is the condition of abundant production and equitable distribution, while the very existence of society depends upon the maintenance of personal liberty.

The condition under which man exists is that he shall work. The work may be mental, manual, or mechanical. Some may be

spared for a time from the necessity of work, but, as has been well said by Colonel Henry Lee, "under a free distribution of property it is but three generations from shirt-sleeves to shirt-sleeves."

The entire capital in the richest nation or state, consisting of railways, mills, factories, workshops, and dwellings, together with all the goods and wares of every kind—comprising all that has been saved in a useful form, aside from opening of the ways, the clearing of the land and bringing it into productive condition—will not exceed three or possibly four years' production; in most states it is less. If all could be reconverted into food, fuel, and clothing, and the world should rest wholly from work, all would be consumed in two or three years. In respect to food, the world is always within a year of starvation, yet there is always enough somewhere. Whether the product of each series of four seasons shall be distributed so that all may share the necessaries of life depends upon personal liberty, upon freedom of exchange, and upon the maintenance of the right of every man "to use his faculties in all lawful ways, to live and work where he will, to earn his livelihood in any lawful calling, and to pursue any lawful trade or avocation." (Judge Peckham, of New York. People *vs.* Gilson, 109 N. Y., 399.)

"The patrimony of the poor man lies in the strength and dexterity of his own hands; and to hinder him from employing these in what manner he may think proper, without injury to his neighbor, is a plain violation of this most sacred property." (Judge Snyder, of West Virginia. State *vs.* Goodwill, 10 S. E. Rep., 287.)

In the progress of invention, and by the application of science to the art of material production, all that can be expected or hoped for in the improvement of the condition of the great body of the people is that the more noxious pursuits may be done away with and that the conditions of the most arduous may be ameliorated; but the work must go on and in the sweat of his brow man must always eat his bread. The true gain that comes in the course of years is that a part of the time which is at the disposal of men may be saved from the necessity of hard work for the enjoyment of more and more leisure. Whether the leisure hours will be well spent or not will rest wholly upon the individual. The best definition of leisure that I have ever met is that "leisure consists in the diligent and intelligent use of time." Time saved from the necessary work of life may be worse than wasted or it may be well spent.

In dealing with this subject we are often brought face to face with a singular paradox. If all were rich, all would be poor alike; each might then be disinclined to serve the other for compensation, and thus all would be obliged to do all their own work with-

out opportunity to save labor by mutual service. Under such conditions life would be hardly worth living. Every kind of work would be required of every man and woman and there would be no rest. It is by the exchange of services that time is saved, both to the employed as well as to the employer. The man who directs the force of the capital in the possession of which he makes himself rich adds vastly more to the common product from which all wages and profits are derived, than he consumes for his own use from that product in the personal support of himself and his dependents. When just relations are established by free contract between rich and poor the service which each renders to the other is an equitable and useful service. Society rests for its very existence upon this interdependence of men and upon the inequality in their personal endowments, whether material or immaterial. The capacity to combine, direct, and use great masses of capital is rare: without this capacity capital becomes inert or it is wasted, while labor becomes less productive the more crowded the area occupied. Hence inequality in possession is the very necessity to the productive application of that which constitutes wealth. The value of a man to the community in which he lives is measured neither by his labor nor by his toil, nor by the number of hours that he works; it is established by the service that he renders, and that rests finally upon the quality of the mental energy with which he is endowed and upon the effectiveness of the forces, material or immaterial, to which he gives direction. The mind of man is the prime factor in the conversion of forces to the end that there may be abundance and leisure in place of scarcity accompanied by long hours of arduous toil.

Such being the conditions, it does not follow that every one may not feel a hearty sympathy with any true effort on the part of those who earn their daily bread by the sweat of their own brows, to shorten the hours of labor so as to save more time for rest and recreation. It is only to the false methods by which these ends are sought that exception can be taken.

When these efforts tend to deprive the very men who seek to be benefited of their own personal liberty, and when their right of free contract is impaired by their own acts, the time has come to discriminate in order to separate the true from the false methods of saving time; or, in other words, to distinguish between the true and the false methods of shortening the hours of labor.

It is customary to define three factors which enter of necessity into the production of all material things—land, labor, capital. There are, in fact, two other factors inseparable from production, and each is as essential as the land, the labor, or the capital —namely, the mental power, or, in other words, the mental energy

which is required to direct the processes of labor and capital and the time that is required for the sequence of the several processes of production.

Among these five factors, land, labor, capital, mental energy, and time, there is but one in which all men must share alike. All others are variable. One only is equal and constant, and that is time.

The hours of the day number twenty-four. Whether a man be rich or poor, whether well endowed with mental energy or not, the one opportunity, the one element of property, which all must share alike, is time. Time is a common factor, and yet it is also a separate factor, an element of individual property, with which every man may claim to deal according to his own will so far as he may not impair the rights of others to deal with their share of time at their own will.

It follows that any legal restrictions upon the free use of time impair personal liberty more than almost any other interference with the freedom of men that can be conceived. Such restrictions create inequality in that which in its nature must be shared by all alike.

Yet, step by step, and session by session, the Legislatures of almost every State are enacting statutes restricting the use of time, which, when enforced, create monopolies, establish privileged classes and inflict disabilities. Under pretense of police ordinances or under the pretext of maintaining the public welfare these acts deprive great bodies of citizens of their right of free contract and of the free disposal of their own time according to their own will, even in lawful and in innocuous pursuits in the conduct of which no harm can arise to any other person, although the man himself who chooses to do so may overwork himself.

These restrictions have been carried to such an extent as to have perverted the very moral sense of great numbers of workmen. Many combinations and associations have made demands upon the Legislature to limit adult men and women in the use of their own time who do not wish to be limited by legal restrictions imposed both upon the workman and the employer. The attempt has been made to put a brand or mark of disgrace upon other workmen who choose to maintain their own personal liberty by calling men "scabs" or "rats" and other opprobrious terms, who control their own time and maintain their right to free contract. Resort has even been had in very many cases to force, in this futile attempt to substitute the despotism of democracy through the misuse or abuse of the power of the majority for the despotism of the kings and of the privileged classes whose rule we have thrown off.

It matters not that all such attempts must fail because the

free men who maintain their own personal liberty will in the end secure the best positions and the most lucrative occupation. These efforts, so long as they have a temporary effect, tend to the privation of the very men who move for the enactment of restrictive statutes or who subject themselves to the rules of the associations which limit them in the use of their own faculties.

It is the very province of the political economist to expose the wrong, even if it offends the very men who wrong themselves, and to appeal to the decisions of the courts in order to establish their rights as well as the rights of those who will not submit to their restrictions.

It does not yet seem to have occurred to any of those who are oppressed by such public statutes, or by the rules and regulations of private associations by which the attempt is made to restrict the free use of time, that a remedy may be found in the courts for any infringement of personal liberty, under whatever pretense the public act may have been passed. It may, therefore, be expedient to pass in review some of the cases in which this issue has already been joined.

In order that the firm foundation on which personal liberty rests may be fully comprehended, we may go back almost to the beginning, and we must recur once again to a familiar chapter of the English-speaking people.

The barons who wrested the charter of English liberty, the Magna Charta, from King John, nearly eight hundred years ago, were only maintaining the long existing and established rights of the free men of England against the usurpation of a despotic ruler. Strange that the counterpart of that ruler may be found to-day in the legislatures of our own time.

Personal liberty was established in the Magna Charta in these terms:

"No free man shall be taken or imprisoned or disseised, or outlawed, or exiled, or anyways destroyed; nor will we go upon him, nor will we send upon him, unless by the lawful judgment of his peers or by the law of the land."*

In the brief limits permitted for the statement of this case we may not follow the course of history, century by century; but we must pass at once to a very noted instance in which the rights of the people were established by the English courts, the "case of monopolies," so well known to all students of law and so often cited. In the time of Elizabeth, the Queen had under taken to grant to the plaintiff the monopoly of making and selling playing-cards. The court held this grant to be void, and in giving the opinion

* "Nullus liber homo capiatur, vec imprisonetur, aut dissaisiatur, aut utlagetur, aut exuleter, aut aliquo modo destruatur, nec super eum ibimus, nec super eum mittemus, nisi per legale judicium parium suorum, vel per legem terræ."

cited a previous case in which it had already been held that even a chartered company which had undertaken to establish a somewhat similar privilege had gone beyond its powers. The record of the previous case in part is cited in the following terms (The Case of Monopolies, 11 Coke Rep., 86 a):

"And a case was adjudged in this court, inter Davenant and Hurdis, Trin. 41, Eliz. Rot. 92, where the case was that the company of Merchant Taylors in London having power by charter to make ordinances for the better rule and government of the company, so that they are consonant to law and reason, made an ordinance that every brother of the same society who should put any cloth to be dressed by any cloth worker not being a brother of the same society, shall put one half of his cloths to some brother of the same society . . . upon pain of forfeiting ten shillings . . . and it was adjudged that the ordinance, although it had the countenance of a charter, was against the common law, because it was against the liberty of the subject; for every subject by the law has freedom and liberty to put his cloth to be dressed by what cloth worker he pleases, and cannot be restrained to certain persons, for that would in effect be a monopoly; and therefore such ordinance, by color of a charter or any grant by charter to such effect, would be void."

Again, if any man or woman, or if any family, may choose at this time to work machines in their own houses for a period of time or for a number of hours in the day beyond what is permitted by statute law to be done in the factory, and any one shall molest them, the decision in which it was first held that "a man's house is his castle" may be cited in defense of the personal liberty of the owner and of his right to dispose of his time, of his looms which may constitute his capital, and of his labor in such manner as may serve his own purpose in the best way, according to his own judgment. He may not be forbidden to do that kind of work in his house which is forbidden when conducted in a factory.*

Passing on again by more than a century, we come to one of the great landmarks in the establishment of the liberty of the English-speaking people, noted in the history of jurisprudence—the decision of Lord Camden forbidding action under general warrants. (Entick *vs.* Carrington, 2 Wis. 275, 1765.) The Earl of Halifax, principal Secretary of State, issued a warrant to arrest John Entick "and him having found you are to seize and apprehend and to bring together with his books and papers in safe custody before me." Entick brought trespass against the king's messengers for seizing his papers under this warrant.

* A declaration that a man's house is his castle, and that he may defend it against violence, is contained in Semayne's case, 5 Rep., 91 a (2d Jac. 1).

Lord Camden, C. J. (p. 291): "Our law holds the property of every man so sacred that no man can set his foot upon his neighbor's close without his leave. . . . The defendants have no right to avail themselves of the usage of these warrants since the revolution. . . . We can safely say there is no law in this country to justify the defendants in what they have done; if there was, it would destroy all the comforts of society; for papers are often the dearest property a man can have."

Only a little later, passing to our own side of the ocean, we again find a complete condemnation of all modern acts which impair personal liberty in one of the prime causes of the War of the Revolution. When James Otis resisted the writs of assistance, by which the attempt was being made to compel the citizens of Boston to assist the Surveyor of Duties in searching vaults, cellars, warehouses, shops, and other places for goods which might have been imported contrary to act of Parliament, he cited the common law of England as controlling acts of Parliament, as laid down by Lord Coke.*

When this appeal failed, the colonists threw off the power by which they had been oppressed and adopted the remedy, the terms of which are so well stated by Mr. Justice Gray in his exhaustive review of this chapter in the history of American jurisprudence.†

We are thus brought near to our own time and to the decisions of our own courts, by which personal liberty has been re-established and the right of every man to control the disposition of his own time may be maintained. It seems passing strange that one must resort to the decisions of the courts in order to find a true definition of personal liberty. One would have thought that it would have been found in the very statutes which the courts have annulled.

The very power which Parliament had assumed and which caused the colonies to rebel is now in some directions assumed by the Legislature of Massachusetts. The remedy lies in an appeal to the common law, which is the common heritage of the English-speaking people everywhere, and in this country has been embodied in our written Constitution and Bill of Rights.

Among the many decisions of the courts sustaining the right of every man *sui juris* either to combine with others in the pursuit of a common end, so long as such union or association did not impair the equal right of any one to work at his own will or "for his own hand" outside such unions or associations, none have been more lucidly or firmly presented than those given by Chief-Justice Shaw, of Massachusetts. (Commonwealth *vs.* Hunt, 4

* Bonham's case, 8 Rep., 118 a. † Quincy's Reports, Appendix I, p. 540.

Metcalf, 111, 1842.) The attempt had been made to hold certain men guilty of conspiracy because the members of a union or society had agreed not to work for any person who employed others not members of such union. The learned judge held (p. 128): "The averment is this—that the defendants and others formed themselves into a society, and agreed not to work for any person who should employ any journeyman or other person not a member of such society after notice given him to discharge such workman. . . . (p. 130) The case supposes that these persons are not bound by contract, but free to work for whom they please, or not to work if they so prefer. In this state of things we can not perceive that it is criminal for men to agree together to exercise their acknowledged rights in such a manner as best to subserve their own interests."

The right of the workman to free contract is fully sustained by this decision; he is left as free to refuse to work as he is free to work upon any terms that he may choose to work.

But when the attempt of a slave-master to control the service of him who had been held a slave in another State was made, Chief-Justice Shaw maintained the right of personal liberty in terms which no Congress, no Legislature, and no court would now dare to contravene.*

When Legislatures and trades-unions attempt to impair the personal liberty of men, and to take from them the right to control their own time, the act differs only from the claim of the slave-holder in degree but not in kind; and when an appeal is taken to the courts, the great judge may again annul the act or the ordinance, citing in support of his decision Chief-Justice Parsons, who declared that no slave could breathe the air of Massachusetts; and Chief-Justice Shaw, who ruled that no man should even attempt to impair the personal liberty of him who dwelt upon our soil, even were it only for a single day.

In the case of the People *vs.* Gilson, adjudicated in New York in 1888 (New York Reports, vol. 109, p. 389), Justice Peckham gave a broad and lucid construction to the term "liberty" in the following words (p. 398): "The term 'liberty,' as used in the Constitution, is not dwarfed into mere freedom from physical restraint of the person of the citizen, as by incarceration, but it is deemed to embrace the right of man to be free in the enjoyment of his faculties with which he has been endowed by the Creator, subject only to such restraints as are necessary for the common welfare. Liberty in its broad sense, as understood in this country, means not only the right of freedom from servitude, imprisonment, or restraint, but the right of one to use his faculties

* Commonwealth *vs.* Aves, 18 Pick., 193 (1836).

in all lawful ways, to live and work where he will, to earn his livelihood in any lawful calling, and to pursue any lawful trade or vocation."

The case before the court was one affecting methods of sale of any article of food. The Legislature had enacted a law (chap. 691 of 1887) that "No person shall sell, exchange, or dispose of any article of food, or offer or attempt to do so upon any representation, advertisement, notice, or inducement that anything other than what is specifically stated to be the subject of the sale or exchange is or is to be delivered or received or in any way connected with or a part of the transaction as a gift, prize, premium, or reward to the purchaser."

In respect to this specific act Judge Peckham held it unconstitutional for the following reasons (p. 405): "It seems to me that to uphold the act in question upon the assumption that it tends to prevent people from buying more food than they may want, and hence tends to prevent wastefulness or lack of proper thrift among the poorer classes, is a radically vicious and erroneous assumption, and is to take a long step backward and to favor that class of paternal legislation which, when carried to this extent, interferes with the proper liberty of the citizen and violates the constitutional provision referred to."

In dealing with an act which had been passed to prevent the manufacture of tobacco in tenement-houses, in cities of more than five hundred thousand inhabitants—an act which was specifically aimed at the cities of New York and Brooklyn—Judge Earl held, in the case of Jacobs, 98 New York, p. 98 (1885), that the act was unconstitutional.

Attention may well be called to the vigor with which the learned judge denies the power of the Legislature to construe its own acts by the titles which it may give to them. The assumption of power under the indefinite term of police regulations may not be admitted. The court may demand the facts to be submitted—proof absolute, clear, and definite of the injury to the common welfare may be required before personal liberty can be impaired and the right of free contract taken away, in order that the court may be satisfied that there is reasonable cause to sustain the regulation as one rightly coming within the term of police powers.

A decree in legislative form may present an aspect of legality but may yet be wholly unlawful. Lord Brougham ruled that "things may be legal and yet unconstitutional," even in England where there is no written constitution. Even Parliament has been overruled and called upon to submit to the rule of the courts, when it has impaired the personal liberty of the subject in a manner which is in contravention of the common law, although the act of Parliament may have been wholly consistent with legal forms.

Among the many judges who have ruled in defense of personal liberty none have given more well-considered and vigorous decision than Justice Snyder, of West Virginia. In the year 1887 the Legislature of West Virginia passed an act (chap. 63) to prevent the payment of wages by the issue of what are known as shop orders, or for certain values of goods drawn upon their own shops. This act was held to be unconstitutional (State *vs.* Goodwill, 10 S. E. Report, 285 (W. Va., 1889)). Justice Snyder held as follows (p. 287):

"The property which every man has in his own labor, as it is the original foundation of all other property, so it is the most sacred and inviolable. The patrimony of the poor man lies in the strength and dexterity of his own hands; and to hinder him from employing these in what manner he may think proper without injury to his neighbor is a plain violation of his most sacred property. It is equally an encroachment both upon the just liberty and rights of the workman and his employer, or those who might be disposed to employ him, for the Legislature to interfere with the freedom of contract between them; as such interference hinders the one from working at what he thinks proper, and at the same time prevents the other from employing whom he chooses. A person living under the protection of this Government has the right to adopt and follow any industrial pursuit, not injurious to the community, which he may see fit. And, as incident to this, is the right to labor or employ labor; make contracts in respect thereto upon such terms as may be agreed upon by the parties; to enforce all lawful contracts; to sue and give evidence; and to inherit, purchase, lease, sell, and convey property of every kind. The enjoyment or deprivation of these rights and privileges constitutes the essential distinction between freedom and slavery; between liberty and oppression."

In dealing with the specific act, Judge Snyder (p. 288) declared it to be "a species of sumptuary legislation which has been universally condemned as an attempt to degrade the intelligence, virtue, and manhood of the American laborer, and foist upon the people a paternal government of the most objectionable character, because it assumes that the employer is a tyrant and the laborer is an imbecile."

In the research which the writer has been enabled through the assistance of his coadjutor, Mr. E. T. Cabot, to make in the preparation of this treatise, he has been unable to find any direct adjudication upon the subject of the free use of time.

That no statute may stand which discriminates by classes or by persons in the free use of time, has been well established by a decision in the highest court of California.

A statute of 1880 (p. 80) provided that "it shall be unlawful

for any person, engaged in the business of baking, to engage or permit others in his employ to engage, in the labor of baking for the purpose of sale, between the hours of 6 P. M. on Saturday and 6 P. M. on Sunday, except," etc. The question of the constitutionality of this statute was raised in *Ex parte* Westerfield, 55 Cal., 550. Judge Myrick gave the decision in the following terms:

"This is special legislation. A certain class is selected. As well might it have said, if master carpenters or blacksmiths, or if attorneys having clerks, shall labor or permit employés to labor, they shall be deemed guilty of a misdemeanor and be punished; carpenters or blacksmiths, not master-workmen, or attorneys without clerks, may labor at their will. The baking of bread is in itself lawful and necessary. Even if there be authority to restrain the labor on some one day, it must be if at all under a general law restraining labor on that day." Again it is held that if some may not work according to their own will, the rule must be uniform, and all who are engaged in pursuits of like kind must be subjected to the same rule.

Analogous to the use of time is the method of payment. When the State of Pennsylvania attempted to regulate the method of payment which should be adopted under compulsion by the employers who were engaged in mining or manufacturing, and when the State also provided that no employer should sell supplies to the employés at any greater profit than that received from other employés, the Supreme Court declared the statute void.*

In Illinois the Legislature attempted to provide for the weighing of coal at the mines under different conditions from the conditions of weighing or delivery which might apply in other places. The court held the act unconstitutional, as being class legislation.†

The State of New York passed an act against excluding persons from equal enjoyment of places of amusement on account of race, color, or previous condition of servitude, and this act was sustained.‡

There could be no clearer statement of the right of every man to make contracts and to enjoy the free use of time for such number of hours as may be agreed upon by his employer, than that given by Judge Andrews in this case. The learned judge declares not only that life, liberty, and property must be protected, but that every person must be protected in every essential incident in the enjoyment of his rights. Can there be a more essen-

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* Godcharles *vs.* Wigeman, 113 Pa. St., 431. † Millett *vs.* The People, 117 Ill., 294.
‡ People *vs.* King, 110 N. Y., 418.

tial incident to the enjoyment of life, liberty, and property than the unrestricted use of time which all may and must share alike unless prevented by unlawful interference?

We may now observe a tendency in many arts, through the progress of science and invention, to pass out of the great factory so as to become again household industries under better conditions, more favorable to production, and less arduous in their conduct than these same branches of industry formerly were before science and invention had come to their aid and had removed them from the house to the factory. The application of water-power to the conduct of the work in the factory rendered it necessary to place the factory in the narrow valleys alongside the river below the fall, and that tended to the concentration of great bodies of men and women in the textile factory. When these branches of industry were first established and were operated by water-power on a large scale, such had been the arduous conditions of life among the farmers of New England that the well-bred daughters of these farmers found it expedient to go from the farm to the factory, where they worked in low-studded, ill-ventilated, badly lighted, and badly heated rooms fourteen hours a day for a measure of earnings only one half that which their successors secure to their own enjoyment, working ten hours a day in a modern, high-studded, well-ventilated factory.

There has been a natural progress in saving time which is due to the application of art and science to production. Science and invention have shortened the hours of work in spite of the meddlesome interference of statutes, and will continue to do so, paying little regard to statute law except so far as restrictions upon the use of time may put off the day rather than hasten it when the hours of work may be shortened yet more.

The application of steam and illuminating gas again tended to concentrate great forces of men and women in the workshop and in the factory and in the upper stories of city warehouses. The power of steam can not be sent far distances. Illuminating gas can only be carried in large pipes at light pressure on short lines. This phase is passing. Profound changes are working. By means of a wire, power, light, and the direction of the work can be carried long distances. The power of the waterfall in the narrow gorge where there is no room for a factory can be carried on the wire to the far-away uplands, where under the best conditions of life the workshops may be established. Fuel-gas distilled from coal by the seaside or near the bank of the river may be carried in small pipes at high pressure far away from the source where it is generated.

We are just entering upon the period of rapid transit underneath the ground, by means of which men and women may be

moved at will from the center of the great city where they have been confined in the slums to the broad areas of the suburbs where, under better conditions of life, the same work may be conducted even in their households. Is it to be pretended that by the power of legislation the State constable may enter the household of a free citizen of this country and may prescribe to him, his wife, and his children how they shall work and what number of hours they shall operate the loom, the knitting-machine, the sewing-machine, or any other of the appliances which may be set in motion by electrical power, lighted by electric light, and directed by electrical speech at the touch of a button in the wall? If the State constable may not enter the household, may not invade the home, he may not enter the factory or invade "the close," to use the old-time term cited by Lord Camden, where men and women may choose to work according to their own will and to control their own time according to their own judgment.

One may not defend this abuse of legislation under the pretense that it comes within the police power of the State. True, the Supreme Court of the United States has left these matters up to this time to State legislation, but its justices have more than once laid down the rule under which the Legislatures must act or else the supreme power of the land may forbid any restriction upon personal liberty.*

In view of the certainty with which these principles have been laid down and will be maintained by all the courts of this country, may it not be judicious to put an end to the continual attempts of sentimentalists, of pseudo-reformers, and of unenlightened workmen, to impair the personal liberty of adult men and women and to take from them their right of free contract by an appeal to the courts of highest jurisdiction?

Among the facts which Mr. Hugh Nevill cited at the International Congress of Orientalists to illustrate the theory of a philological connection between Egypt and India, was the use of rice-boats by the Goyi caste of Ceylon, which curiously recalls the oracle-boats of Egypt. Rice was still pounded for ceremonial festivals in these boats of stone or wood, while at the ruins of Amrajapura large stone boats were found of dates between B. C. 200 and A. D. 400, which were used to hold rice for the royal alms. The use of an image of Kâmadhenu, the celestial cow, among the Tamils of southern India and Ceylon, must be regarded as a survival of Isis-worship. The image was used as a car at Mulaition, to support an image of Tântondiswara, or Siva, the self-created. The myth and custom were of obscure antiquity, the celestial cow typifying, in southern Indian mythology, the fertility of Nature. The author did not assert that the affinity observed between Egypt and India came from the former place to the latter; for it might or might not date from a time and place before Isis-worship reached its great seat in Egypt.

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*Calder vs. Bull, 3 Dal., 386 (p. 388).

THE STORY OF A STRANGE LAND.

By DAVID STARR JORDAN.
PRESIDENT OF THE LELAND STANFORD JUNIOR UNIVERSITY.

"In one strange land,
And a long way from home,
I heard a mighty rumbling, and I couldn't tell where."
—*Negro Melody.*

IT happened a long time ago, it may be fifty thousand years in round numbers, or it may have been twice as many, that a strange thing took place in the heart of the Great Mountains. It was in the middle of the Pliocene epoch, a long, dull time that seemed as if it would never come to an end. There was then on the east side of the Great Divide a deep, rocky basin surrounded by high walls of granite gashed to the base by the wash of many streams. In this basin, we know not how—for the records all are burned or buried—the crust of the earth was broken, and a great outflow of melted lava surged up from below. This was no ordinary eruption, but a mighty outbreak of the earth's imprisoned forces. The steady stream of lava filled the whole mountain basin and ran out over its sides, covering the country all around so deeply that it has never been seen since. More than four thousand square miles of land lay buried under melted rock. No one can tell how deep the lava is, for no one has ever seen the bottom. Within its bed are deep clefts whose ragged walls descend to the depth of twelve hundred feet, and yet give no glimpse of the granite below, while at their side are mountains of lava whose crags tower a mile above the bottom of the ravines.

At last, after many years or centuries—time does not count for much in these Tertiary days—the flow of melted lava ceased. Its surface cooled, leaving a high, uneven plain, black and desolate, a hard, cold crust over a fiery and smoldering interior. About the crater lay great ropes and rolls of the slowly hardening lava, looking like knots and tangles of gigantic reptiles of some horrible extinct sort. There was neither grass nor trees, no life of any sort. Nothing could grow in the coarse, black stone. The rivers and brooks had long since vanished in steam, the fishes were all dead, and the birds had flown away. The whole region wore the desolation of death.

But to let land go to waste is no part of Mother Nature's plan. So even this far-off corner of her domain was made ready for settlement. In the winter she sifted snow on the cold black plain, and in the summer the snow melted into a multitude of brooks and springs. The brooks gradually wore paths and furrows down the large bed, and the sands which they washed from one place

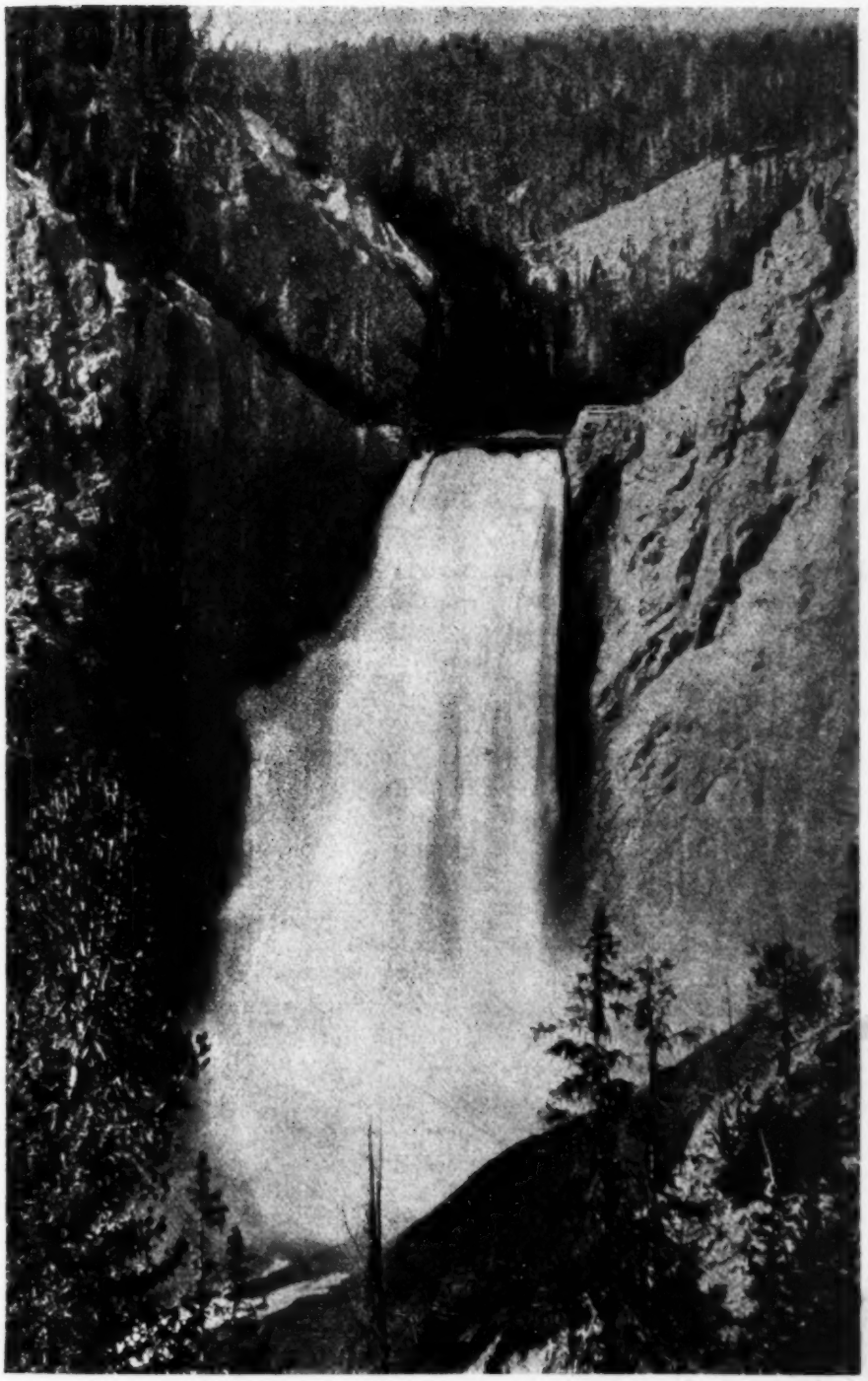
they piled up in another. The winds blew the seeds of grasses about, and willows and aspens crept up the mountain-sides. Then came the squirrels, scattering the nuts of the pine. Other seeds came, too, in other ways, till at last the barren hillside was no longer barren.

The brooks ran over the surface of the crust undisturbed by the fires within, and were clear and cold as mountain brooks should be; but the rain and melted snow will never all remain on the surface. Some of it falls into cracks or joints or porous places in the rock, and from this come underground streams or springs. But in this region a stream could not run long underground without coming in contact with the old still-burning fires. When a crust is formed over the lava, it cools very slowly. When the crust is a rod or two deep, the lava within is almost as well protected as if it were at the center of the earth.

Whenever the water came down into the fire, the hot rocks would be furious with indignation, and tearing the water to atoms they would throw it back to the surface as steam. Then the explosive force of the steam would in turn tear up the rocks, making still larger the hole through which the water came. When the rocks were very hot, a little water upon them would make a terrible commotion like the shock of an earthquake. When much water came down, it would hiss and boil high in the air, as it tried to break the cushion of steam which came between it and the lava.

And all this went on in hundreds of places and maybe for thousands of years. The hot rocks glowed and sweltered in the ground, and the cold snow-water crept after them closer and closer, while more and more vigorously the rocks resented the intrusion. Sometimes the water would go down in a mass through a cleft, when it would be hurled back bodily the very way it came. At other times the water came down little by little, insinuating itself into many places at once. Then the hot rocks threw it back in many little honeycomb channels, and by the spreading of these channels the rocks were at last crumbled to pieces. The hard black lava or the glass-like obsidian were changed to white kaolin as soft and powdery as chalk. And as the water fought its way, gaining a little every year, steadily working between the joints in the enemy's armor and as surely being thrown back with violence if it penetrated too far, the animals and the plants followed in the wake of the water, and took possession of the territory as fast as it was won.

At last the Pliocene times were over, for all times come to an end. The one sure thing on the earth is the certainty of change. With the change of time came on the earth's great winter. The snow-drifts on the lava were piled up mountain-high. Snow is



LOWER OR GREAT FALLS OF THE YELLOWSTONE RIVER.*

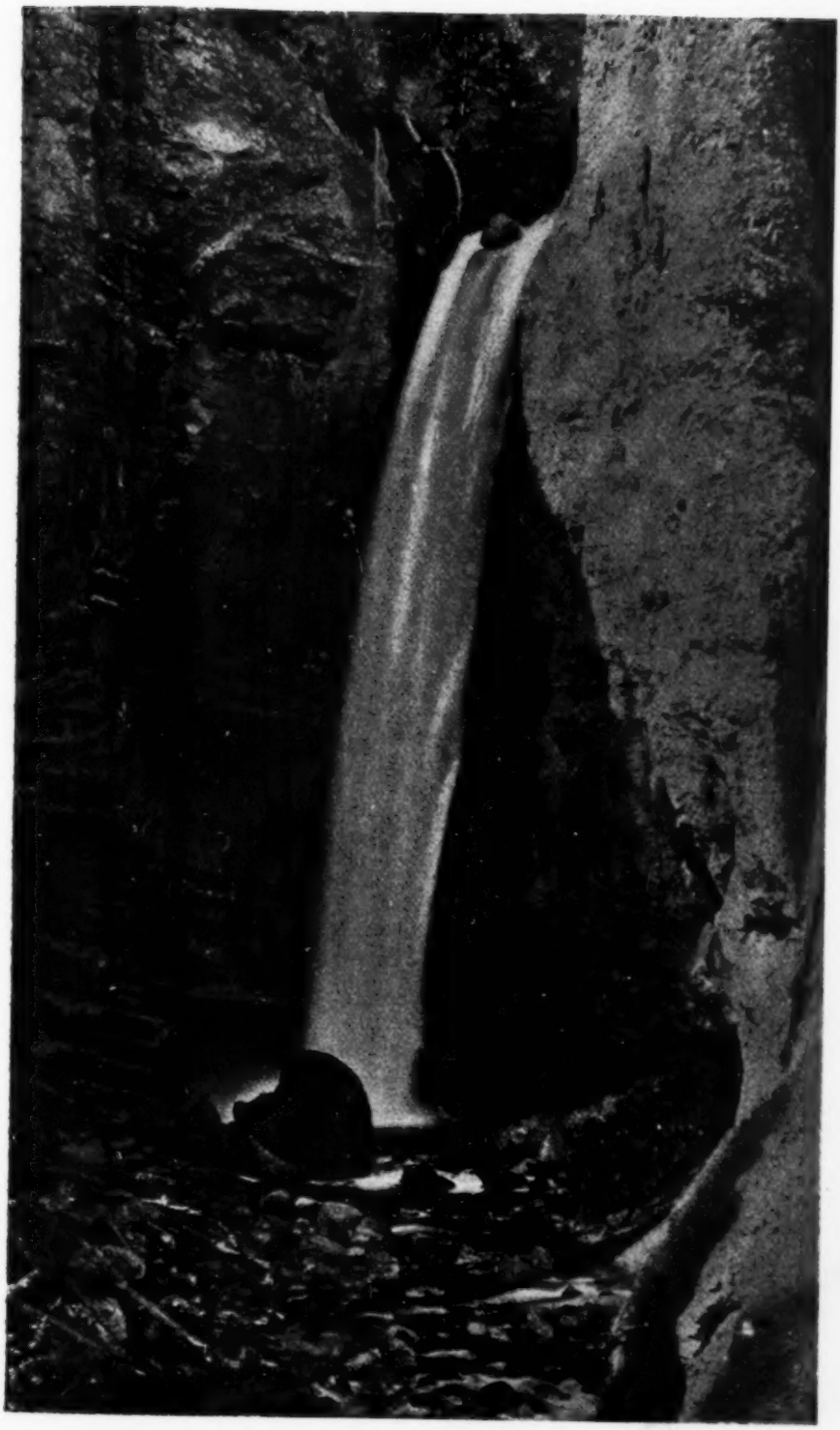
* We are indebted for the illustrations in this article to the kindness of Hon. Marshall McDonald, of the United States Fish Commission.

but ice gathered in little fragments which will grow solid under pressure. As the snow accumulated it began to move, forming great rivers of ice which ran down the courses of the streams. And as these slowly moving, gigantic ice-rivers tore away huge blocks of lava and pushed them down the mountain-sides, where the rocks had been softened by the action of steam, the ice wore out deep valleys, and everything that it touched was smoothed and polished. The winter of the great Ice age lasted a very long time, many thousands of years; but, long as it was and long ago, it came at last to an end—not to a full stop, of course, for even now some of its snow still lingers on the highest peaks that surround the lava-beds.

Then the winters grew shorter and the summers longer. The south winds blew and the ice melted away, first from the plain and then from the mountains. The water ran down the sides of the lava-bed, cutting deep gorges or cañons, so deep that the sun can hardly see the bottom. And into the joints and clefts of the rocks more and more water went, to be hurled back with greater and greater violence, for all the waters of all the snow can not put out a mile deep of fire.

In the old depressions where the ice had chiseled away the softer rocks there were formed lakes of the standing water, and one of these was more than thirty miles long, winding in and out among the mountain-ridges. In the lake bottom the water soaked through down to the hot lava below, from which it was thrown boiling back to the surface again, fountains of scalding water in the icy lake.

The cold Ice age had killed all the plants in the region; it had driven off the animals that could be driven, and had then buried the rest. But when the snow was gone the creatures all came back again. Grass and meadow-flowers of a hundred kinds came up from the valleys below. The willow and the aspen took their place again by the brookside, and the red fir and the mountain pine covered the hills with their somber green. The birds came back. The wild goose swam and screamed, and the winter wren caroled his bright song—loudest when there seemed least cause for rejoicing. The beaver cut his timber and patiently worked at his dams. The thriftless porcupine destroyed a tree for every morning meal. The gray jay, the "camp-robber," followed the Indians about in hope that some forgotten piece of meat or of boiled root might fall to his share; while the buffalo, the bear, and the elk each carried on his affairs in his own way, as did a host of lesser animals, all of whom rejoiced when this snow-bound region was at last opened for settlement. Time went on. The water and the fire were every day in mortal struggle, and always when the water was thrown back repulsed, it renewed the contest as vigor-



Tower Falls of Tower Creek.

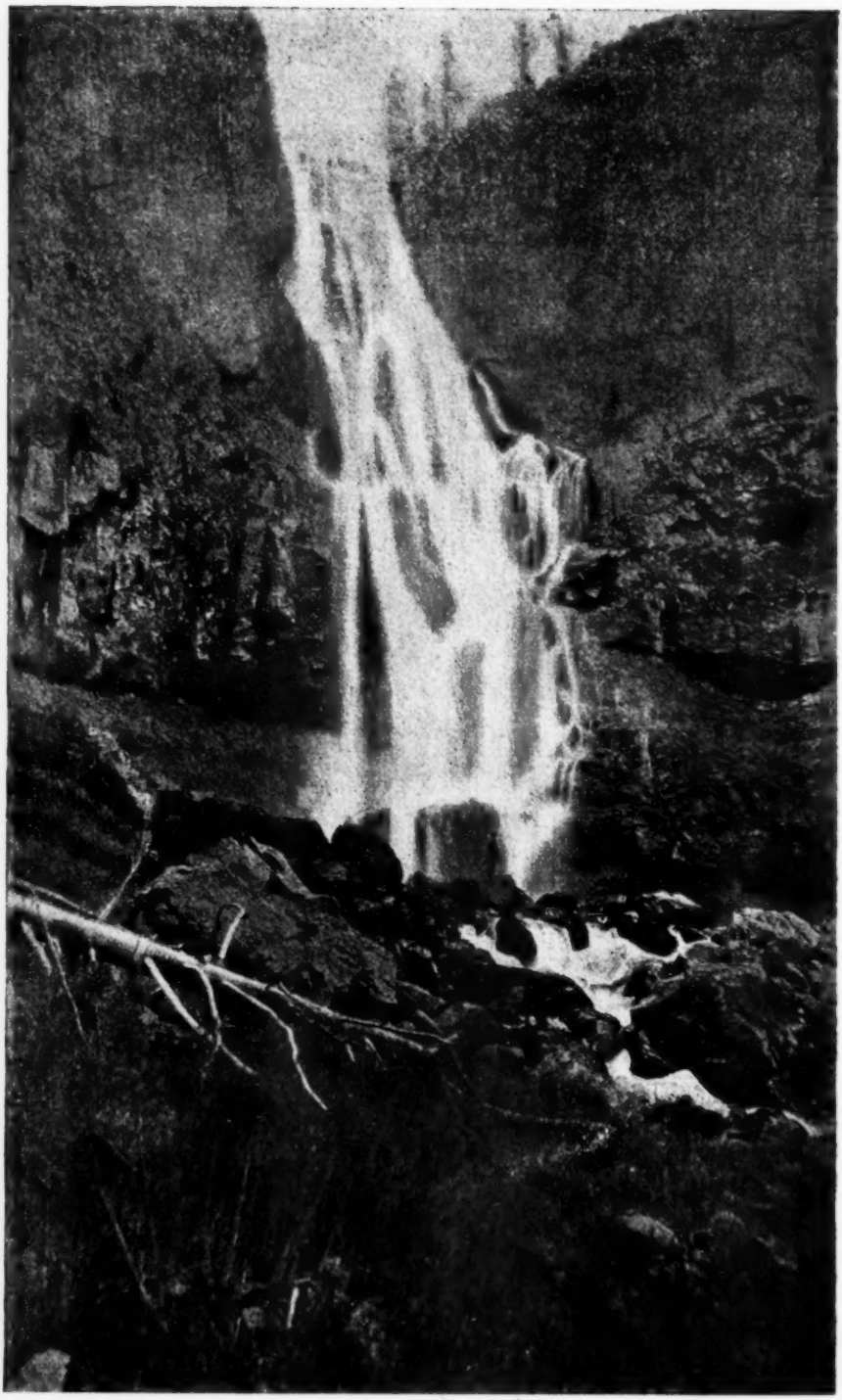
Undine Falls of Lava Creek.

ously as before. The fire retreated, leaving great stretches of land to its enemy, that it might concentrate its strength where its strength was greatest. And the water steadily gained, for the great ocean ever lay behind it. So for century after century they wrestled with each other, the water, the fire, the snow, the animals, and the plants. But the fishes who had once lived in the mountain torrents were no longer there. They had been boiled and frozen, and in one way or another destroyed or driven away. Now they could not get back. Every stream had its cañon, and in each cañon was a waterfall so high that no trout could leap up. Although they used to try it every day, not one ever succeeded.

So it went on. A great many things happened in other parts of the world. America had been discovered and the colonies were feeling their way toward the Pacific Ocean. And in the vanguard was the famous expedition of Lewis and Clarke, which went overland to the mouth of the river Columbia. John Colter was a hunter in this expedition, and by some chance he went across the mountains on the old trail of the Nez Percés Indians which leads across the Divide from the Missouri waters to those of the Columbia. When he came back from the Nez Percés trail he told most wonderful tales of what he had seen at the head of the Missouri. There were cataracts of scalding water which shot straight up into the air; there were blue ponds hot enough to boil fish; there were springs that came up snorting and steaming, and which would turn trees into stone; the woods were full of holes from which issued streams of sulphur; there were cañons of untold depth with walls of ashes full of holes which let off steam like a locomotive, and there were springs which looked peaceful enough, but which at times would burst like a bomb.

In short, every one laughed at Colter and his yarns, and this place where all lies were true was familiarly known as "Colter's Hell." But for once John Colter told the truth, and the truth could not easily be exaggerated. But no one believed him. When others who afterward followed him over the Nez Percés trail told the same stories, people said they had been up to "Colter's Hell" and had learned to lie.

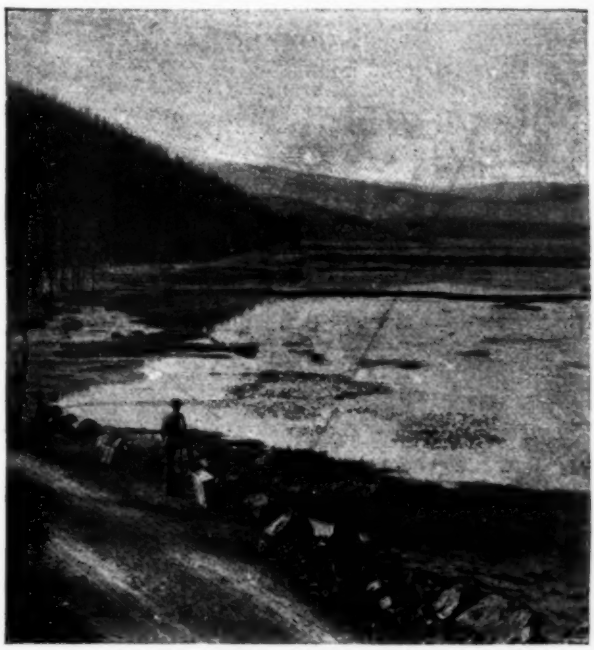
But, as time passed, other men told what they had seen, until, in 1870, a sort of official survey was made under the lead of Washburne and Doane. This party got the general bearings of the region, named many of the mountains, and found so much of interest that the next year Dr. Hayden, the United States Geologist, sent out a party for systematic exploration. The Hayden party came up from Colorado on horseback, through dense and tangled forests, across mountain torrents, and over craggy peaks. The story of this expedition has been most charmingly told by its youngest member, another John Coulter. Prof. Coulter was the botanist



Osprey Falls of Gardiner River.

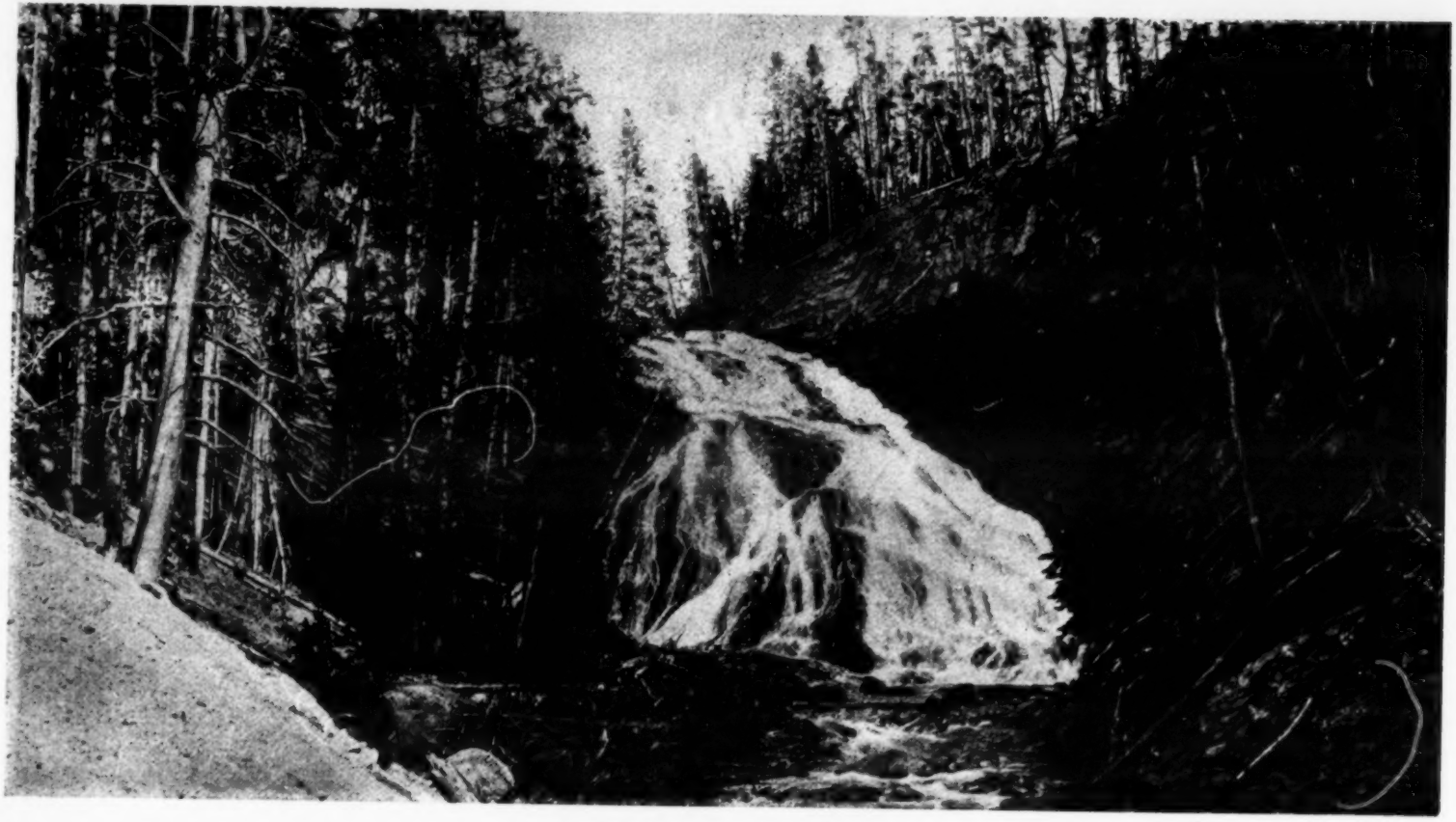
of the survey, and he won the first of his many laurels on this expedition. In 1872, acting on Hayden's report, Congress took the matter in hand and set apart this whole region as a "public park or pleasuring ground for the benefit and enjoyment of the people," and such it remains to this day.

But, while only of late this region has had a public history, the long-forgotten years between the Glacial period and the expedition of Lewis and Clarke were not without interest in the history of the trout. For all these years the fishes have been trying to mount the waterfalls in order to ascend to the plateau above.



BEAVER LAKE; SHOWING BEAVER DAMS.

Year after year, as the spawning-time came on, they leaped against the falls of the Gardiner, the Gibbon, and the Firehole Rivers, but only to fall back impotent in the pools at their bases. But the mightiest cataract of all, the great falls of the Yellowstone, they finally conquered, and in this way it was done: not by the trout of the Yellowstone River, but by their brothers on the other side of the Divide. These followed up the Columbia to the headwaters of the Snake River, its great tributary, past the beautiful Heart Lake, and then on to the stream now called Pacific Creek, which rises on the very crest of the Divide. In the space between this stream, which flows west to help form the Snake River, and a smaller stream now called Atlantic Creek, flowing down the



VIRGINIA CASCADE OF GIBBON RIVER.

east slope of the Divide, the great chain of the Rocky Mountains shrinks to a narrow plateau of damp meadow, not a fourth of a mile in width; and some years, when the snows are heavy and melt late in the spring, this whole region is covered with standing water. The trout had bided their time until they found it so, and now they were ready for action. Before the water was drained they had crossed the Divide and were descending on the Atlantic side toward the Yellowstone Lake. As the days went by, this colony of bold trout spirits grew and multiplied and filled the waters of the great clear lake, where their descendants remain to this day. And no other fishes—not the chub, nor the

KEPPLER'S CASCADE OF FIREHOLE RIVER.

sucker, nor the white-fish, nor the minnow, nor the blob—had ever climbed Pacific Creek. None of them were able to follow where the trout had gone, and none of them have ever been seen in the Yellowstone Lake. What the trout had done in this lake—their victories and defeats, their struggles with the bears and pelicans, and with the terrible worm, joint enemy of trout and pelicans alike—must be left for another story.

So the trout climbed the Yellowstone Falls by way of the back staircase. For all we know, they have gone down it on the other side. And in a similar way, by stealing over from Black-tail Deer Creek, they overcame the Undine Falls in Lava Creek and passed its steep obsidian walls, which not all the fishes in the world could climb.

In the Gibbon River the cataracts have proved to the trout an impassable barrier; but, strangely enough, its despised associate, the sluggish, chunky blob, a little soft-bodied, smooth, black, tadpole-like fellow, with twinkling eyes and a voracious appetite—a fish who can not leap at all—has crossed this barrier. Hundreds of blob live under the stones in the upper reaches of the stream, the only fish in the Gibbon waters. There he is, and it is a standing puzzle even to himself to know how he got there. We might imagine, perhaps, that some far-off ancestor, some ancient Queen of the Blobs, was seized by an osprey and carried away in the air. Perhaps an eagle was watching and forced the osprey to give up its prey. Perhaps in the struggle the blob escaped, falling into the river above the falls, to form the beginning of the future colony. At any rate, there is the great impassable waterfall, the blob above it and below. The osprey has its nest on a broken pine tree above the cataract, and its tyrant master, the bald eagle, watches it from some still higher crag whenever it goes fishing.

Two years ago the Hon. Marshall McDonald, whose duty as United States Fish Commissioner it is to look after the fishes wherever they may be, sent me to this country to see what could be done for his wards. It was a proud day when I set out from Mammoth Hot Springs astride a black *cayuse*, or Indian pony, which answered to the name of Jump, followed by a long train of sixteen other *cayuses* of every variety of color and character, the most notable of all being a white pony called Tinker. At some remote and unidentified period of her life she had bucked and killed a tradesman who bestrode her against her will, and thereby, as in the old Norse legends, she had inherited his strength, his wickedness, and his name. And when, after many adventures, I came back from this strange land and told the story of its fishes, other men were sent out from Washington with nets and buckets. They gathered up the trout and carried them to the rivers above the falls, and now all the brooks and pools of the old lava-bed, the fairest streams in the world, are full of their natural inhabitants.

MENTIONING some peculiarities in the distribution of plants in Great Britain—that it has a southern flora opposite France, a Germanic flora on the east coast, a Lusitanian flora in the southwest, and on the extreme west two American plants unknown elsewhere in Europe—Mr. Clement Reid expresses the belief that in the Britain of the present day we may study the repeopling of a country over which everything has been exterminated, and, until we have fuller direct evidence of the stages of the process, we may safely accept Greenland and Britain as illustrating the way in which Nature works to fill gaps in the fauna and flora, whether these are caused by changes of climate, by volcanic agency, or by the submergence and reappearance of islands.

URBAN POPULATION.

LESSONS FROM THE CENSUS. IV.

By CARROLL D. WRIGHT, A. M.,
UNITED STATES COMMISSIONER OF LABOR.

THE admirable work of Mr. William C. Hunt, special agent in charge of the Population Division of the Census Office, and of Dr. John S. Billings, U. S. A., expert special agent in charge of the Division of Vital Statistics of the Census, enables one to study the relations of urban to country population, and the social statistics of cities. Taking the work of these skillful statisticians and the information which has been collected from other sources, I am able to draw a distinctive lesson relative to congested districts in cities.

In the census of 1880 urban population was defined as that element living in cities or other closely aggregated bodies of population containing eight thousand inhabitants or more. The Superintendent of the Eleventh Census remarks that "this definition of the urban element, although a somewhat arbitrary one, is used in the present discussions of the results of the eleventh census in order that they may be compared directly with those of earlier censuses." He considers the limit of eight thousand inhabitants a high one, inasmuch as most of the distinctive features of urban life are found in smaller bodies of population. According to this definition, the urban population of the United States in 1890 constituted 29·12 per cent of the total population. The following brief table gives the proportion for the several censuses since and including that of 1790:

Census Years.	Population of the United States.	Population of cities.	Inhabitants of cities in each 100 of the total population.
1790	3,929,214	131,472	3·35
1800	5,308,483	210,873	3·97
1810	7,239,881	356,920	4·93
1820	9,633,822	475,135	4·93
1830	12,866,020	864,509	6·72
1840	17,069,453	1,453,994	8·52
1850	23,191,876	2,897,586	12·49
1860	31,443,321	5,072,256	16·13
1870	38,558,371	8,071,875	20·93
1880	50,155,783	11,318,547	22·57
1890	62,622,250	18,235,670	29·12

It will be seen that the proportion of urban population has gradually increased from 3·35 per cent in 1790 to 29·12 per cent, or nearly one third of the total population, in 1890. The number of cities having a population of more than eight thousand increased

from 6 in 1790 to 286 in 1880, since which time the number has grown to 443. New York was the only city in 1880 which had a population in excess of one million, but Chicago and Philadelphia now come into this list. The cities in 1870 which contained more than one hundred thousand inhabitants numbered 14, in 1880 they had increased to 20, and in 1890 to 28. The North Atlantic Division of States, with a population of 17,401,545, contains an urban population of 8,976,426, or 49·22 per cent of the entire urban population of the country. The population of the South Atlantic Division is 8,857,920, and the urban population is 1,420,455, or 7·79 per cent of the entire urban population of the United States. The Northern Central Division, the largest group in the country, has a total population of 22,362,279, and it has a large urban population (5,791,272), which is 31·76 per cent of the entire urban population. The Southern Central Division contains 10,972,893 inhabitants, but its urban population is small, it being 1,147,147, or 6·29 per cent of the urban population of the country. The Western Division, being the smallest group and having 3,027,613 inhabitants, has a city population of 900,370, which is 4·94 per cent of the entire urban population. While the North Atlantic Division contains nearly one half the urban population of the entire country, 51·58 per cent, or more than one half of its own population, is contained in cities of eight thousand or more inhabitants, and during the past ten years this urban element in this division has increased 43·53 per cent, while the total population has increased but 19·95 per cent. The greatest numerical increase in the urban element is to be found in Maine, Vermont, Massachusetts, and New York, so far as the North Atlantic Division is concerned; so that in the States named the rural population must have actually diminished. Of course, this rapid increase in the urban population of the North Atlantic Division finds its cause in the great extension of manufactures and commerce, lines which require the aggregation of inhabitants in restricted localities. This large increase of city population is due in some degree to annexations to already existing cities, but this makes no particular difference with the fact itself, that there is a large and rapidly increasing city population as compared with the population of rural districts.

The bare statement of the facts which I have cited often causes great apprehension as to the character of our population and as to the rapid growth of the influence of cities as controlling powers in the politics of the country, and very frequently it excites the fears of students of social science relative to the supposed increased intensity of the congestion in cities of the slum population. It is upon this latter point that I have for some years made more or less examination, and with a conclusion different from that of statisticians and writers generally. The limits of this series of

papers will not allow me to take up more than three of our largest cities, and I have selected those which have had the largest experience and for which I could most readily study the facts. The population by wards of the cities of New York and Philadelphia for 1870, 1880, and 1890, and for Boston for 1880 and 1890, is shown in the following tables:

New York.

Wards.	1870.	1880.	1890.
First	14,463	17,939	11,122
Second	1,312	1,608	929
Third	3,715	3,582	3,765
Fourth	23,748	20,993	17,809
Fifth	17,150	15,845	12,385
Sixth	21,153	20,196	23,119
Seventh	44,818	50,066	57,366
Eighth	34,913	35,879	31,220
Ninth	47,609	54,596	54,425
Tenth	41,431	47,554	57,596
Eleventh	64,230	68,778	75,426
Twelfth	47,497	81,800	245,046
Thirteenth	33,364	37,797	45,884
Fourteenth	26,436	30,171	28,094
Fifteenth	27,587	31,882	25,399
Sixteenth	48,359	52,188	49,134
Seventeenth	95,365	104,837	103,158
Eighteenth	59,593	66,611	63,270
Nineteenth	86,090	158,191	231,864
Twentieth	75,407	86,015	84,327
Twenty-first	56,703	66,536	63,019
Twenth-second	71,349	111,606	156,859
Twenty-third	.....	28,338	53,948
Twenty-fourth	.....	13,288	20,137
Total	942,292	1,206,299	1,515,301

Philadelphia—Population by Wards.

Wards.	1870.	1880.	1890.
First	25,817	43,082	53,882
Second	30,220	28,498	31,563
Third	19,149	18,274	19,925
Fourth	20,852	18,854	20,384
Fifth	18,736	16,372	16,987
Sixth	12,064	10,004	8,712
Seventh	31,558	31,080	30,179
Eighth	22,286	19,547	16,971
Ninth	16,629	12,481	9,791
Tenth	23,312	23,362	21,514
Eleventh	14,845	12,929	12,953
Twelfth	15,171	14,690	14,170
Thirteenth	19,956	18,646	17,923
Fourteenth	22,643	22,353	20,737
Fifteenth	44,650	47,866	52,705
Sixteenth	19,256	17,802	17,087
Seventeenth	21,347	20,451	19,546
Eighteenth	26,366	29,358	29,164
Nineteenth	45,240	43,887	55,545

Wards.	1870.	1880.	1890.
Twentieth	56,642	43,207	44,480
Twenty-first	13,861	19,699	26,900
Twenty-second	22,605	31,798	45,329
Twenty-third	20,888	26,644	35,294
Twenty-fourth	24,932	46,071	42,556
Twenty-fifth	18,639	36,108	35,945
Twenty-sixth	36,603	35,138	62,138
Twenty-seventh	19,385	23,333	32,905
Twenty-eighth	10,370	34,443	46,390
Twenty-ninth	.....	40,787	54,759
Thirtieth	.....	29,098	30,614
Thirty-first	.....	31,308	32,974
Thirty-second	.....	.....	30,050
Thirty-third	.....	.....	33,171
Thirty-fourth	.....	.....	23,721
Total	674,022	847,170	1,046,964

Boston—Population by Wards.

Wards.	1880.	1890.	Wards.	1880.	1890.
First	14,773	19,633	Fifteenth	14,902	18,049
Second	15,153	17,297	Sixteenth	15,184	18,048
Third	11,514	13,094	Seventeenth	14,445	15,638
Fourth	11,257	12,842	Eighteenth	13,142	16,035
Fifth	10,960	12,412	Nineteenth	19,971	23,016
Sixth	16,904	18,447	Twentieth	17,391	24,335
Seventh	12,550	13,145	Twenty-first	14,711	22,930
Eighth	12,792	13,026	Twenty-second	12,715	20,011
Ninth	12,611	12,660	Twenty-third	14,032	24,997
Tenth	11,503	8,205	Twenty-fourth	16,871	29,638
Eleventh	16,602	21,660	Twenty-fifth	6,693	12,032
Twelfth	14,696	12,585			
Thirteenth	21,462	22,375	Total	362,839	448,477
Fourteenth	20,005	26,367			

Wards 1 and 2 comprise East Boston; Wards 3, 4, and 5 comprise Charlestown; Wards 13, 14, and 15 comprise South Boston.

The population of Boston by wards for 1870 can not be stated, because the geographical boundaries of wards were changed in 1875; but other data relative to Boston can be used for the illustration of the point I desire to make. In the other cities named, New York and Philadelphia, the geographical boundaries of wards have been identical under the last three Federal censuses. From the foregoing tables I have combined what might be called the "congested" wards of each of the cities. Eliminating these from all the wards, and constructing a new table, we have the facts relative to the population for all wards for the years named, for the congested wards stated separately, and for the remaining wards, in each of the cities. This table is as follows:

	Population.			Gain, 1870 to 1890.	Percentage of gain, 1870 to 1890.
	1870.	1880.	1890.		
New York.					
Total all wards	942,292	1,206,299	1,515,301	573,009	60·81
Total congested wards *	545,653	593,914	596,831	51,178	9·38
Total remaining wards	396,639	612,385	918,470	521,831	131·56
Philadelphia.					
Total all wards	674,022	847,170	1,046,964	372,942	55·33
Total congested wards †	436,272	401,795	407,631	‡ 28,641	‡ 6·56
Total remaining wards	237,750	445,375	639,333	401,583	168·91
Boston.				1880 to 1890.	
Total all wards	.....	362,839	448,477	85,638	23·60
Total congested wards *	.....	98,074	99,094	1,020	1·04
Total remaining wards	.....	264,765	349,383	84,618	31·96
Boston.					
Total	250,526	362,839	448,477	197,921	79+
Boston proper	138,781	147,075	161,330	22,549	16+
Annexations	111,745	215,764	287,147	175,402	156+

A study of this last table throws great light upon the supposed concentration of population in the slums of the cities named. In New York the increase in the congested wards (and I have taken for this purpose all the wards south of Fourteenth Street) was in the twenty years from 1870 to 1890 but 51,178, or 9·38 per cent; while the increase for the whole city for the twenty years was 573,009, or 60·81 per cent. The remaining wards, or those north of Fourteenth Street, were the territory where nearly all this last-named gain took place. It was 521,831, or a gain from 1870 to 1890 of 131·56 per cent. Certainly during the twenty years there has been no perceptible increase of population in the congested territory described.

Turning to Philadelphia, and taking the compact wards, we find there has been a loss in the twenty years of 28,641, or 6·56 per cent, the wards other than the congested wards showing a gain of 401,583, or 168·91 per cent, while the total gain for the whole city was 372,942, or 55·33 per cent.

Similar conditions are shown for Boston. In the first section of the preceding table relating to Boston the population for 1880 and 1890 only is given, as explained. This shows that in the ten years named the congested wards, which include all the slum population of the city, the gain was only 1,020, or 1·04 per cent; while in the remaining wards there was a gain of 84,618, or 31·96 per cent. The second section of the table relating to Boston shows the population for 1870, 1880, and 1890 for the whole city—for Boston proper, that is, the old city territory prior to any of its

* First to seventeenth inclusive, except the twelfth, which is an outlying ward.

† Second to twentieth inclusive, except the fifteenth. ‡ Loss.

* The sixth, seventh, eighth, tenth, twelfth, sixteenth, and seventeenth.

annexations, and the population of the annexations. In the twenty years the population of Boston gained, including all, 197,921, or 79+ per cent; the old city proper gained but 22,549, or 16+ per cent; while the population of the annexations increased 175,402, or 156+ per cent, in the twenty years.

These facts certainly remove all apprehension as to the increase of the slum population of the cities named, and I submit that it is perfectly reasonable that the population of such districts can not increase; and that, while there is a great setting of people toward our cities, they are found as a rule among the suburban population, in healthy sanitary districts; and that whatever influx there is to the slum localities is entirely offset by the outgoing people from such districts.

After collecting the material for this chapter, my attention was called to an exceedingly valuable article in the October Contemporary Review, by Mr. Sidney J. Low, entitled The Rise of the Suburbs. Mr. Low, taking his figures from the recent census of England, that of last spring, makes a table of some of the typical districts of inner London, on both sides of the river, with their rates of increase or decrease since 1881, which is as follows:

District.	Rate of increase or decrease per cent.
City of London	25·5 decrease.
Westminster	19·9 "
Strand	18·2 "
St. Giles	12·1 "
St. George, Hanover Square	10·4 "
Holborn	6·8 "
St. George-in-the-East	3·4 "
Shoreditch	2·0 "
Bethnal Green	1·7 increase.
Mile End	1·8 "
St. Olave, Southwark	1·4 "
Kensington	4 9 "
Whitechapel	4·3 "

In regard to these districts, Mr. Low remarks that some of them are wealthy residental districts, while many of them are poor and others altogether poverty-stricken. "Bethnal Green, Whitechapel, St. Olave, Southwark, and parts of St. Pancras, St. Giles, and Holborn," he says, "are tinted with a very dark brush on Mr. Charles Booth's excellent comparative maps of London poverty." And he further says: "It is not unsatisfactory to find that the dwellers in these localities are obeying the great law of centrifugal attraction, and quitting the inner recesses of the metropolis to find homes in the outskirts. The people who leave Hatton Garden, and Commercial Street, and Hoxton, and Seven Dials, either forced out by 'improvements' or voluntarily retiring, do not go to the country—that we know well enough; nor do the country folks

come in to take their places in any large numbers. For the immigrant from the congested districts of the town, and for the emigrant from the decaying rural parishes, we must look to the suburbs; and we find him there, if figures can tell us anything. Compare, with the list just given of stationary or declining areas in central London, the statistics for a few of the regisration divisions which lie farther out:

District.	Increase per cent since 1881.
Camberwell	26·1
Woolwich	32·8
Wandsworth	46·1
Hampstead	50·5
Fulham	64·5
Tottenham	95·0
Willesden	121·9
Leyton	133·5

"Here is where the increase of 'Greater London,' with its five and a half millions of inhabitants, is found. It is not, as hasty observers have imagined, in the teeming alleys of 'Darkest London,' or in the warren of rabbit-hutches which spreads for a mile or two north and south of the Thames. The center of population is shifting from the heart to the limbs. The life-blood is pouring into the long arms of brick and mortar and cheap stucco that are feeling their way out to the Surrey moors and the Essex flats and the Hertfordshire copses. Already 'Outer London' is beginning to vie in population with the 'Inner Ring'; a few decades hence, and it will have altogether passed it."

These figures for different portions of London are exceedingly significant, and show precisely the same conditions as are shown by the facts which I have already grouped relative to New York, Philadelphia, and Boston, and they show conclusively that the movement is greatly different from what it is often supposed to be. To again quote Mr. Low: "The population is not shifting from the fields to the slums; and the slums themselves are not becoming fuller, but the reverse. So far from the heart of the city being congested with the blood driven from the extremities, we find, on the contrary, that the larger centers of population are stationary, or thinning down; it is the districts all round them which are filling up. The greatest advance in the decade is shown not in the cities themselves, but in the ring of suburbs which spread into the country about them. If the process goes on unchecked, the Englishman of the future will be of the city but not in it. The son and grandson of the man from the fields will neither be a dweller in the country nor a dweller in the town. He will be a suburb-dweller. The majority of the people of this island will live in the suburbs; and the suburban type will be the most wide-

spread and characteristic of all, as the rural has been in the past and as the urban may perhaps be said to be in the present." This aspect of affairs is perfectly reasonable, and is the only condition that could have been expected. It should be remembered that the cities named are great mercantile and manufacturing centers, their prosperity developing rapidly, and it should also be remembered that the rapidity of the development of cities in commercial or industrial ways retards the growth of population in the compact quarters to a very large degree. Every time an advance is made along a street by the extension of business houses, the families living there are crowded out; they may move to other parts of the city or locate in the suburbs; in either event there is only a shifting of population, and not an increase. The transfer of great manufacturing establishments from the city to the country carries large numbers of families, or if the transfer is made within the city limits there is simply a change in location of the population interested in the establishment. In taking the Federal census of 1880 for the State of Massachusetts I discovered a loss in one of the wards of the city of Boston; but I found upon investigation that the removal of one establishment from that ward to another in a distant part of the city had carried with it more than one thousand people; so the increase in the population of the part of the city to which the removal was made apparently indicated growth. Cities lay out new streets and avenues, necessitating the tearing down of rookeries and crowded tenement-houses. Every such improvement displaces a large number of families, who seek a residence either in some other part of the city or in the suburbs. Thus, the building of a large number of houses, often referred to as an evidence of increase of population, may not mean any increase whatever. If a hundred families are crowded out of their old locations by improvements or by the encroachments of trade, there is an immediate demand for a hundred new tenements, which makes it appear that the population is increasing rapidly, when there is no increase. That the argument that new houses always indicate an increase of population is unanswerable can not be admitted, for very frequently the reverse is true; even in a country town a new house or a dozen new houses may not indicate an increase of a single person in the population, as it may be entirely the result of the improved financial condition of one or several families formerly living in the same house. The building of new houses is an indication of prosperity and of increase, but not positive evidence of increase. The retarding influence of the increase of trade and of manufactures must be felt more and more as their extension becomes more rapid, and in all great cities where large business blocks are erected in place of crowded tenements there must be a dispersion of population.

I think that what has been said in regard to New York, Philadelphia, and Boston, and of the city of London, would prove true of any large commercial or manufacturing center. The encouragement to be drawn from this state of facts is great indeed, and should relieve the popular mind of the constant fear of the increase of the slums of our great cities. I wish that an investigation might be made that would show the exact number, character, and condition of the people living in the slums, and whether the geographical territory inhabited by the slums is being enlarged, or whether the actual number on restricted territory is being increased. Such an investigation, whatever it might show, would be of immense value in the study of urban population.

STILTS AND STILT-WALKING.

By M. GUYOT-DAUBES.

SYLVAIN DORNON, a stilt-walker of the Landes, left Paris on the 12th of March, 1891, for Moscow, and reached the end of his journey after fifty-eight days of walking. This long walk on stilts was a subject of wonder, not to the Russians only, to whom this method of locomotion was unknown, but to Dornon's own countrymen as well.

Walking on stilts, which was common some twenty years ago in certain parts of France, is gradually going out of use. In the Landes of Gascony it was formerly a means of locomotion well suited to the nature of the country. The Landes were large continuous plains, covered with scrub bushes and scanty heaths; and, in consequence of the impermeability of the subsoil, all the hollows were transformed after a light rain into marshes. There was no road or path. The population, of sheep-farmers, was greatly scattered. The shepherds evidently conceived and adopted stilts in order to be able to move about under these peculiar conditions. The stilts of the Landes are called there *tchangues*, a word in the *patois* of the country meaning long legs, and the persons who use them are called *tchangués*, or long-legged. They are long sticks, which have at the mean height of about five feet from the ground a stirrup to support the foot. The upper part of the stick is shaved flat and supported against the leg, where it is held in place by a strong strap. The lower part, which stands on the ground, is expanded, and is sometimes re-enforced by a sheep-bone. The stiltsman is assisted by a third stick, which serves him for a variety of uses. It supports him in mounting his stilts, and can be used for a crook in driving his sheep; or, with the addition of a piece of board, it forms a comfortable seat fitted to the height

of the stilts. Resting after this fashion, the stiltsman appears as if seated on a gigantic tripod. When he stops, he knits or spins on the distaff which he carries in his belt.

His usual costume is made up of a kind of sleeveless vest of sheepskin, linen gaiters, and a drugget cloak. On his head he wears a *béret* or a large hat. This outfit was formerly supplemented with a gun for defending the sheep against wolves, and a frying-pan in which to prepare dinner.*

The appearance of the Landais peasants is extremely picturesque, but their life is miserable; they are generally puny and thin, badly fed, and often threatened by fever. Mounted on their stilts, they lead their sheep across the Landes, going over the bushes and herbs, the little ponds, and safely crossing the marshes, without having to look for roads or beaten paths. This elevation, moreover, permits them easily to overlook their sheep, which are often dispersed over a considerable surface. To put on his stilts in the morning, the shepherd sits on the window-sill or climbs upon the chimney-piece; and even when he is in the open field he can attach them while sitting on the ground, and then rise with the assistance of his third stick.

Locomotion on stilts is evidently calculated to suggest peril to persons who are accustomed to walking only on the feet. We estimate the possible danger of a fall from the height of these implements from our experiences of ordinary pedestrians' falls; but the Landais, habituated from infancy to this sort of exercise, acquire extraordinary ease and skill in it. The *tchangué* is perfectly able to preserve his equilibrium; he marches with long strides, halts in a standing position, runs with agility, or executes an occasional acrobatic turn, picking up a stone from the ground, plucking a flower, pretending to fall and rise quickly, or running in a lock-step, etc.

The speed attained by stiltsmen is easily explained, when we regard the superior length of the stride which they can make without enlarging the angle of separation of the legs.

When the Empress Josephine went to meet Napoleon at Bayonne in 1808, the municipality sent a company of young Landais stiltsmen to escort her. Turning back, they very easily kept up with her carriages, although the horses trotted rapidly. During her sojourn at Bayonne, the shepherds on their stilts gave much amusement to the ladies of the court. They ran races, threw money on the ground and all tried to pick it up at once, and performed many exercises of cunning and skill, accompanied with frequent falls. Until very recently hardly any festivals took

* A representation from Nature, of a shepherd of the Landes on his stilts, can be seen in the hall of the Provinces of France, at the Ethnological Museum of the Trocadéro.

place in the villages of Gascony without stilt-races. The prizes usually consisted of a gun, a sheep, a rooster, or something of the kind; and young women sometimes took part in the exercises. Some of the municipalities near Bayonne and Biarritz still organ-

FIG. 1.—SYLVAIN DORNON, LANDAIS STILT-WALKER. (From a photograph by M. Bacour, of Arcachon.)

ize stilt-races, at the seasons when travel to them is greatest; but it is said that the stiltsmen who perform at such times are not real Landais shepherds, but are casuals picked up as they may be found, most frequently from among professional acrobats.

Besides attaining considerable speed, the Landais stiltsmen are

able to run long distances without appreciable fatigue. Formerly, on market days at Bordeaux, long lines of peasants could be seen arriving on stilts, who, though encumbered with sacks and baskets, had come from villages ten, fifteen, or twenty leagues and farther away. Now, the sight of a man on stilts is almost as great a curiosity in Bordeaux as in Paris. The peasant of the Landes comes to the city in a wagon or by railroad.

Stilts are of common use in the Belgian city of Namur, a town which formerly suffered from the periodical overflows of the Sambre and the Meuse. The streets were at such times converted into streams or ponds, and the inhabitants could communicate with one another only by means of boats or on stilts. This condition has been remedied by suitable public works, but the taste for stilt-races and for the organization of societies of stiltsmen has lasted till the present time.

It is said that the stiltsmen of Namur once procured a valuable privilege for their city. The governor had promised the Archduke Albert to send a band of warriors to meet him who should not be on foot or on horseback. He fulfilled his promise with the assistance of two companies of stiltsmen, who performed their evolutions in the archduke's presence. He was so pleased with the spectacle that he gave a perpetual exemption to the city of Namur from the beer-tax. The gratitude of the people toward their stiltsmen, and the esteem in which sports with stilts are held by the youth of Namur, are easily comprehended.

Travelers have seen stilts in ordinary use by natives of several islands of the ocean, especially in Santa Christina of the Marquesas. Here, as in other places, the usage is in consequence of a climatic peculiarity. During the rainy season the lower parts of the island, the surface of which presents few inequalities, are full of marshes, and stilts have been employed from time immemorial as a means of communication over them. It is worthy of remark that the stilts of savage peoples are vastly more ingenious and elegant than those of the Landais shepherds. Marquesan stilts may be seen at the Ethnographic Museum of the Trocadéro and the Marine Museum in the Louvre adorned with really artistic designs and curious sculptures, mostly made with the aid of fire.

Independently of the considerations of facility of communication which have made the use of stilts necessary in some countries, the thought of mounting sticks of greater or less height, in order to appear larger or to excite the curiosity of spectators, seems to have occurred at all times and in all countries. In numerous masquerades artificial giants may be seen—persons who, having thus mounted stilts, excite the admiration of the people. They are a feature of the Italian masquerades. Gigan and his wife are one of the attractions of the carnivals of Lille and Dun-

kirk. In various places we may see Gargantuas, Goliaths, or Saint Georges and Saint Michaels. From the acrobatic point of view, walking on stilts gives occasion for feats of agility easy to execute and amusing to the spectator. Acrobats on stilts have been mentioned in Japan, China, India, and Oceania; and clowns are sometimes seen in circuses executing curious exercises on stilts.

The use of stilts is a sport, an amusement for children. Real stilt-races may be seen every day in public gardens. The peasant youth in the country are adepts in making excellent stilts of forked sticks which they cut in the thickets.

I have been told by a friend that the college students at Brive-la-Gaillarde formerly had a peculiar sport of going on holidays on stilts to what they called viper-hunts. They armed themselves

FIG. 2.—COLLEGIANS OF BRIVE-LA-GAILLARDE RETURNING FROM A VIPER-HUNT ON STILTS.

with a long rod split at the end, and went on stilts, of course, as a precaution against being bitten. When, in the evening, they passed through the city, still on stilts, each carrying at the end of his rod an adder or two which they called asps or black vipers, they excited a sensation. Women and children ran away from them or fled into the houses to get away from their tricks.

It seems to be a great pleasure to men on stilts to try to throw one another down. Every young stiltsman is ready to attack, to push, or to trip his colleagues. In the public gardens of Paris, in the Luxembourg, for example, where many youth amuse themselves with stilts, wrestling and contests became so frequent that once after an accident the authorities were constrained to prohibit them. These games on stilts seem to be attractive also to the children of the Marquesas Islands. Père Mathias, in his ac-

count of his voyage to those islands in 1745, remarks that the game on stilts holds the first rank among the pleasures of the Kanakas. On their stilts, he says, which raise them three or four feet above the ground, they give themselves up to combats, and great is the laughter that greets the fall of the awkward. These contests are traditional at Namur, and constitute a kind of national tournament. The contestants form two parties. Each camp is composed of seven or eight hundred combatants, with a captain, officers, a banner, and a cockade. The stiltsmen come into the grand square, announced by martial music. Each party occupies its side of the place, waiting for the signal for opening. The bells sound at every attack, flags fly from the windows, and a crowd of spectators and friends attend to witness the sport. At the giving of the signal the camps engage in the attack. At the first meeting a large number of the contestants fall heavily to the ground and lie there without being able to rise, exposed to being

FIG. 3.—ANCIENT CONTESTS OF STILTSMEN AT NAMUR.

trodden upon unless some of the friends who accompany them—wife, mother, or sister—come to their assistance, and lift them up with considerable effort and often after unsuccessful attempts. The contestant, set upon his stilts again, precipitates himself anew into the fight, unless he has been hurt too badly by his first fall. It is not necessary to add that these sports are often dangerous.

The stiltsmen of Namur who gave representations before Charles V, Peter the Great, and Bonaparte, preserve piously in their archives and repeat with pride the saying of Marshal Saxe, that "if two armies should clash together with as much energy as the youth of Namur, the affair would not be a battle, but a butchery."

Stilts are no longer in use as a practical means of locomotion. In France the Landes of Gascony have been drained and reclaimed, and are penetrated by roads and coursed by railways. The Landais *tchangués* are gradually disappearing, and soon, probably, their memory will exist only among the octogenarians of the province, or as preserved in the collections of popular traditions. —*Translated for the Popular Science Monthly from La Nature.*

MUSICAL INSTRUMENTS—THE PIANO-FORTE.

By DANIEL SPILLANE.

THE DEVELOPMENT OF AMERICAN INDUSTRIES SINCE COLUMBUS. XII.

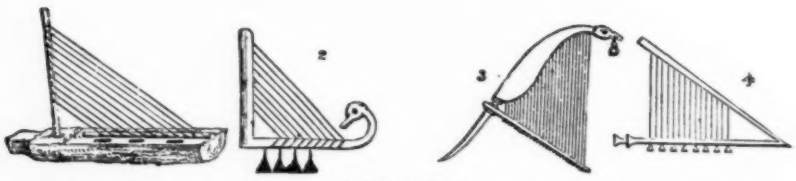
THE place this country holds among modern nations in the production and use of musical instruments is so significant that the fact alone ought to be sufficient to disprove the charge that Americans are too material to appreciate music or the arts. In this and the following article we purpose to treat of the development of musical instruments and their manufacture in America from the historical, technical, and industrial standpoints, with brief sketches of the various improvements and of the individuals identified with them. The piano-forte, the "household orchestra" of the people, is entitled to precedence. Though less complicated and expressive than that "king of musical instruments," the organ, it fills such an important place in social and popular life, and its production maintains such a prosperous art industry, employing within its lines so many gifted men, that this prominence is fully justified.

In treating of the evolution of the piano-forte a little attention must be claimed for the precursors of the instrument. The harp, one of the most ancient, may be traced back in Egyptian history to an indefinable period before Christ. Bruce, the celebrated Scottish traveler and antiquarian, found two paintings, in fresco, of harps on the wall of an ancient sepulchre at Thebes, supposed to be that of Rameses III, who reigned about 1250 B. C. In Thebes, an Egyptian harp was found, in 1823, by Sir John Wilkinson, in an ancient tomb, estimated to be three thousand years old, and when the gut strings were touched they emitted musical sounds. These instruments are illustrated in Fig. 1.

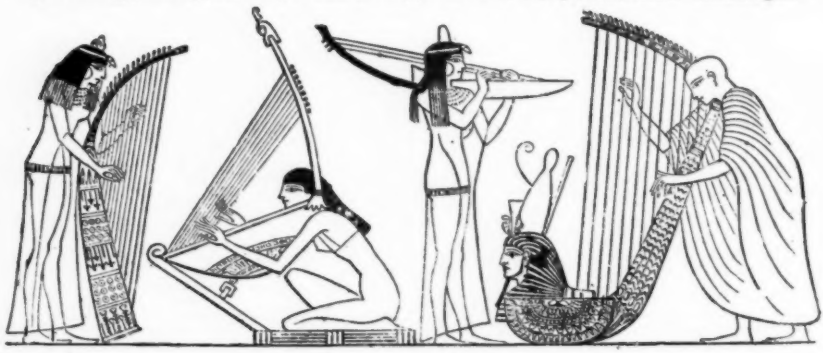
The lyre, a relative form of harp, was also much used in Assyria and Egypt. Ancient sculptures found in Konyunjik, Assyria, now in the British Museum, show two lyres with figures, which further demonstrate its remarkable antiquity. Both instruments

were played with the fingers; sometimes a piece of bone or ivory was used with the lyre as a plectrum.

The dulcimer, which of all musical mediums is nearest to the piano, has been likewise traced into the dim recesses of history,



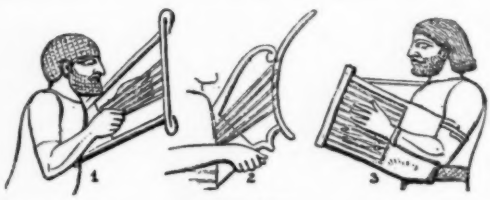
TRIANGULAR HARPS.
1. Ancient Egyptian Harp, from instrument in Egyptian Museum, Florence. 2. Ancient Egyptian Harp (Wilkinson).
3. Ancient Egyptian Harp (Wilkinson). 4. Persian *Chang* (from Persian MS. 410 years old)—Lane's "Arabian Nights."



VARIOUS FORMS OF EGYPTIAN HARPS (ROSELLINI).
1 and 3. Portable Harps for single use. 2. Orchestral Harp. 4. From Painting at Thebes, on tomb of Rameses III.

FIG. 1.

and was known doubtless as early as the harp. In a piece of antique sculpture—an Assyrian bas-relief—in the British Museum, a dulcimer may be seen illustrating the principle of sound production in strings by percussion. Another bas-relief represents a procession of triumph after the victory of Sardanapalus over the Susians, where the dulcimer is used.



ASSYRIAN LYRES.
1 and 2. Sculptures from Konyunjik (British Museum).
3. From Botta's "Nineve."

FIG. 2.

Having shown the antiquity of these instruments of the string family out of which the piano has been evolved, we pass over a space of centuries and come to the next major development of the idea. This was the introduction of finger-keys in the organ, which were in the beginning struck with the clinched fist. Guido is said to have first applied them, in addition to his other historic achievements.

The first instrument of the string family with finger-keys was the clavicytherium, or clavitherum, which the Italians produced about the thirteenth century. This was a form of harp with gut strings in which a key-board was employed with finger-keys to move the mechanical leather plectra used for plucking the strings in lieu of the fingers.

The clavichord, an instrument used up to a recent date, came into existence about the same period as the foregoing, and was another step toward the piano. This, like the two instruments mentioned, derived its name from *clavis*, a key. For the first time gut strings were set aside for wire, which were thrown into musical vibration by a *tangent* moved by a key, thus forming a rude anticipation of the first piano-action mechanism. Sebastian Bach used the instrument in his home for purposes of inspiration and practice, while Mozart is said to have carried one on his musical journeys. Beethoven was also partial to the instrument. It had very many advantages over the harpsichord, the only popular instrument of the Mozart and Bach era. For instance, it was possible to produce rude *piano e forte* effects —which results, first attained in the piano, gave it its title—while it had the faculty of action repetition, and a pleasing attribute of being able to simulate human feeling, such as a violinist or vocalist can produce by sliding from interval to interval. As compared with the piano, however, or even the improved harpsichord of the last century, it was a mere toy.

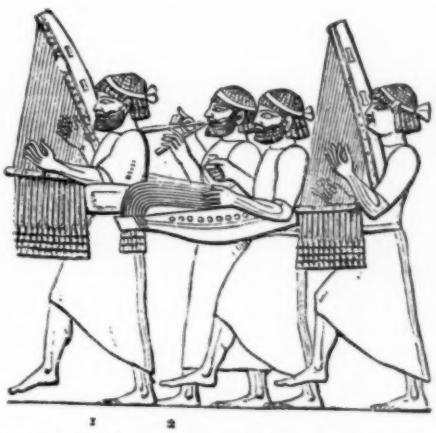


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FIG. 3.—PROCESSION OF TRIUMPH, SHOWING DULCIMER.

The first mention of the instrument discovered in England goes back to 1500, when William Cornish, in his work, A Treatise between Trouth and Informacion, says:

> "The clavichorde hath a tunely knyde
> As the wyre is wrested high and low."

It may have been known previously, however, in that country. Meanwhile, the Germans were generally esteemed as leading clavichord makers at that period.

The virginal and spinet, both forms of the clavicytherium, came next. In these instruments brass-wire strings superseded gut. Instead of a leather plectrum for plucking the strings, a

piece of crow-quill was used attached to a "jack" and operated by a finger-key. The difference between these two instruments was only a slight matter of shape. The virginal was in some cases partially upright. Among the magnificent collection of instruments presented to the Museum of Art by W. A. and Mary E. Brown, of this city, several specimens may be seen. The virginal was a favorite instrument in England during Elizabeth's time. The most noteworthy example of this species in preservation is the Rossi spinet, in the South Kensington Museum collection, London. It has a compass of four octaves and an eighth from E, and is finished in a superb manner. A Player spinet is shown in Fig. 4.

FIG. 4.—SPINET BY PLAYER.
South Kensington Museum, London.

Meanwhile musical art had been developing, the compass of keyed instruments was extending, and the harpsichord duly appeared in Italy, which was the home of musical art almost up to the end of the last century. Toward the end of the sixteenth century it had taken the place of the virginal and spinet in many parts of Europe. The harpsichord was an enlarged and improved form of the latter instruments. Among other original features it contained two strings to each note, which marks another important innovation.

Hans Ruckers, of Dresden—Handel's favorite maker—was the most noted of his time. One of his instruments is at present in the possession of the Metropolitan Museum of Art, having been presented by the late Mr. Drexel, of Philadelphia.

In Italy, Father Zanetti, a Venetian priest, became noted for some improvements in the harpsichord about 1702. Crotone and Farino—two famous Italian makers—later appeared. The latter substituted catgut for wire, going back to the harp principle, but it never won recognition. Meantime, one Rigoli, of Florence, made upright harpsichords as far back as 1621. Coming down toward the introduction of the piano-forte, the names of Silbermann, Stein, Peronnard, Marius, Cristofori, and Tschudi must be mentioned. These were all noted harpsichord-makers, representing Germany, France, Italy, and England, but nearly all of them became identified with the production of the piano.

The piano-forte was invented by Bartolommeo Cristofori, a harpsichord-maker of Padua, Italy, who exhibited four instruments in 1709. The honor was formerly claimed for Marius, a French maker, who produced a piano in 1716; while German writers maintained that Schroeter, of Dresden, was the initiator of the instrument. The earliest date ascribed to the latter's achievement, however, is 1711. During the present century, however, an Italian document was discovered, written by Marchese Scipione Maffei, a Florentine scholar, in 1711, which testifies that Bartolommeo Cristofori, of that city, exhibited four pianos in 1709, which statement was originally published in the Giornale in that year, accompanied by a diagram of Cristofori's action principle, employing hammers, which constituted the chief difference betwen the harpsichord and the piano.

FIG. 5.—HARPSICHORD.

In Maffei's writings Cristofori's name is given as "Cristofali," but this is proved to be an error, because inscriptions upon existing piano-fortes give the name as "Cristofori."

Father Wood, an English monk, living at Rome, is also said to have made a piano-forte similar to Cristofori's in 1711, which he exhibited in England, where it attracted much notice.

FIG. 6.—PIANO BY CRISTOFORI, A. D. 1726. Kraus Museum, Florence.

Cristofori did not remain idle after introducing his first instrument. He became prominently known as a maker, but died in 1731, comparatively poor. Two piano-fortes by Cristofori, at present in Florence, dated 1720 and 1726, show that he anticipated the principles of an improved action, and many other points of equal importance in the structure and acoustics of the instrument. One of these is illustrated in Fig. 6. All authorities admit that he was a great figure and a genius of no common order.

England, backward in the production of musical creators or adjuncts to the art in the past, contributed nothing of consequence to supplant the harpsichord, which instrument was largely imported, until the middle of the last century, when Burckhardt Tschudi, a Swiss, settled in London. Tschudi subsequently engaged in the manufacture of piano-fortes, and incidentally founded

the house of Broadwood & Sons, existing at this date in London, and still eminent as piano manufacturers. Plenius, another London harpsichord-maker, attempted to copy Father Wood's piano-forte, but failed to popularize the form, and ceased manufacturing the instrument in a few years.

Throughout England little was known of the piano-forte until the arrival of twelve workmen in London from German shops, about 1760. This turned the tide of popularity in its favor, for, having had practical experience abroad, they produced instruments of more musical value than those experimental pianos hitherto made by Plenius and Tschudi. These men were familiarly known as the "twelve apostles." From Cristofori's time to 1760 all the piano-fortes made were in the form of "grands," but very diminutive as compared with those of our time. This shape was borrowed from the harpsichord, out of which the piano-forte was evolved. Zumpe, however, a German workman, who went over to London among the group indicated, produced square pianos for the first time, which he sold at a reasonable figure; and this feature, combined with their portable appearance and pleasant touch, won rapid popularity for the instrument.

FIG. 7.—JOHN BROADWOOD.

John Broadwood, the founder of Broadwood & Sons, a young Scotchman, came to London in 1751, and found employment in Tschudi's workshop. He rose rapidly in the favor of his master, and subsequently married the latter's daughter. Afterward becoming a partner, upon the death of Tschudi he inherited the business. Broadwood, by his personal genius as an inventor and workman, rescued Tschudi from being a mere harpsichord-maker, and, toward 1786, Tschudi & Broadwood became pre-eminently known as piano-forte makers. Broadwood was instrumental in introducing the action at present known as the "English grand action," which originated with Backers, a workman in Tschudi's shop, in 1776. Robert Stodart, another graduate of Tschudi's workshop, succeeded to a successful business established by Back-

ers, the inventor of the "English grand action," and died very wealthy. Stodart also contributed many important improvements to the grand. He was followed by his sons, who maintained an excellent record as piano-makers up to recent years.

Sebastian Erard, the founder of the well-known house of Erard, became a leading maker in France toward the end of the last century. He was another important figure in relation to improvements in the grand piano, and also the harp. He was followed by his son Pierre, who became equally famous.

Clementi, the celebrated pianist, a Roman, began business in London in 1800 in partnership with Frederick W. Collard, the latter being the practical partner, and out of this firm the eminent house of Collard & Collard, at present known through Great Britain and Ireland as manufacturers, came. The first Collard was in his time also a great inventor.

Pleyel, Pape, and other French makers appeared soon after the beginning of the century and became famous in Europe as improvers. Many other makers of distinction are known in relation to early piano-making in Germany and elsewhere, but detailed reference to them is impossible here.

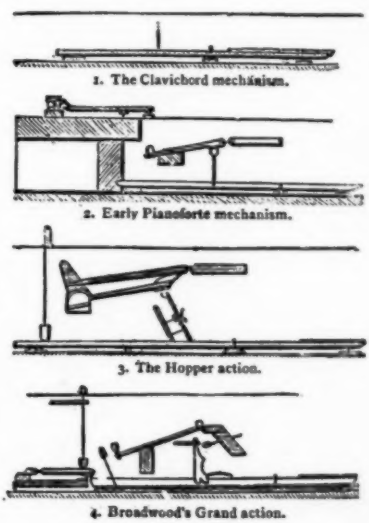

FIG. 8.—ILLUSTRATING THE PARTIAL DEVELOPMENT OF THE PIANO ACTION.

John Broadwood introduced an important improvement in the construction of the square piano in 1783, by altering the position of the tuning-pin block—known technically as the "wrest-plank"—from the front of the instrument to the back, a system which has since then been maintained. He also made some valuable improvements in the construction and position of the sounding-board.

John Geib, a German piano-maker, patented and introduced the first "square action" of value in 1786. This became known as the "grasshopper" action, and held a leading place in England and in this country up to 1840. He also introduced the buff stop. Members of the Geib family were among the pioneer piano and organ builders in New York.

The square piano, which held a favorite place in the United States up to within the past five years, owing to the fact that it was brought to a high point of perfection here, was very popular in Europe as a household instrument up to 1807, when the "cabinet" upright took its place. William Southwell, of Dublin,

some of whose family were prominently known on the early American stage, was the inventor and patentee of the latter instrument. It was produced after fourteen years of persistent endeavor, and, although many persons had previously attempted to make an upright piano-forte of practical value, Southwell was the first to solve the problem in 1807, and it is out of his instru-

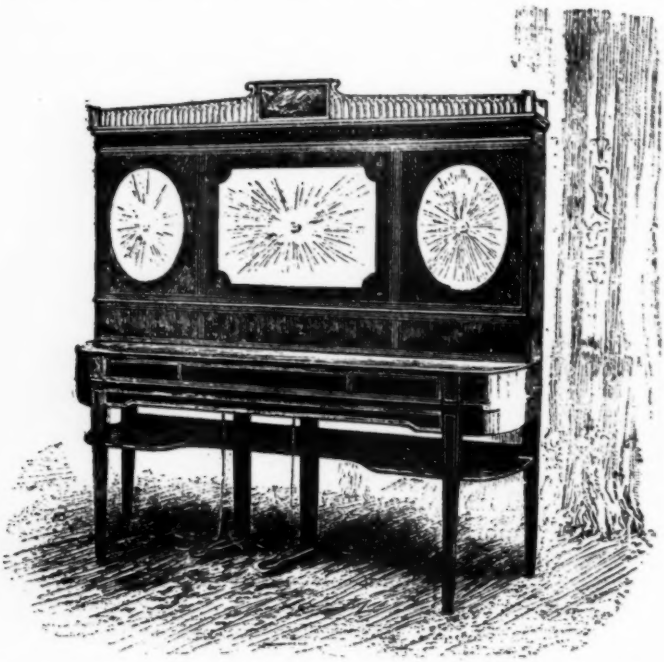

FIG. 9.—SOUTHWELL'S PIANO, A. D. 1798. In the possession of A. Simpson, Esq., Dundee, Scotland.

ment that all subsequent models and modifications of the upright sprang. He also originated the first meritorious upright action ever produced up to his time. This is still known in London as the "Irish" action. One of Southwell's earliest attempts is illustrated in Fig. 9.

It is noteworthy that John Isaac Hawkins, an Englishman, the inventor of ever-pointed pencils, and an engineer by profession, began the manufacture of uprights in Philadelphia in 1800. He took out a national patent in that year for his instrument, which he named "portable grand," and which created quite a furor in that city at the time.

Thomas Jefferson happened to see one of Hawkins's "portable grands" in 1800, while visiting Philadelphia, which he speaks of in the following letter to his daughter: "A very ingenious, modest, and poor young man, in Philadelphia, has invented one of the prettiest improvements in the piano-forte that I have ever

seen, and it has tempted me to engage one for Monticello. His strings are perpendicular, and he contrives within that height to give his strings the same length as in a grand piano-forte, and fixes the three unisons to the same screw. It scarcely gets out of tune at all, and then, for the most part, the three unisons are tuned at once."

One of these instruments is now in the possession of Broadwood & Sons, London. Hawkins was certainly the first to anticipate the modern upright, in its characteristics of portableness, but musically his instrument had no value, and the action principle originated by him was a complete failure. He afterward returned to London, where he achieved an honorable place in his profession. I am indebted to Mr. A. J. Hipkins, the celebrated English writer on musical instruments, and member of Broadwood & Sons, London, for facts given in this connection.

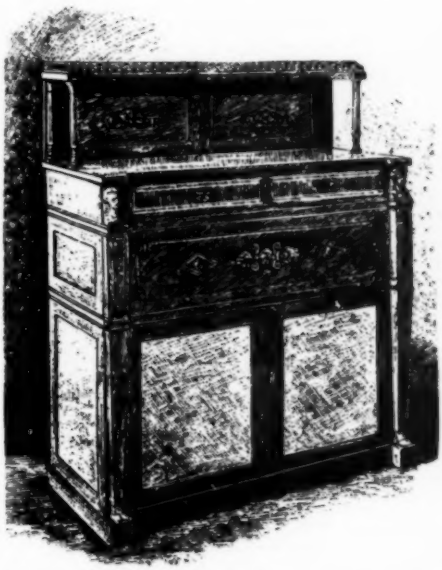

FIG. 10.—FIRST AMERICAN UPRIGHT PIANO, MADE BY HAWKINS IN PHILADELPHIA, 1800. In the possession of Broadwood & Sons, London.

The future of the piano about the beginning of the century depended on the successful introduction of iron; for a point of development had been reached where wooden cases were found inadequate to withstand the tension imposed by heavier stringing and an increased key-board compass. Meanwhile the first notable attempt to introduce iron into the structure of the piano occurred in this country in 1800, when J. Isaac Hawkins, already spoken of, manufactured uprights with iron backs, on which the sounding-board was adjusted. Several rude attempts to employ iron were made subsequently in Europe, but without any degree of success, until Allen and Thoms, two practical workmen in the shop of Stodart in London, originated and patented a system of metal tube and plate bracing in 1820. This attempt was in itself very successful. It became the property of Stodart and proved a fortune to him, but, although an improvement on the old methods, it was far from being adequate to the demands of musical progress. Pleyel, of Paris, and Broadwood, of London, followed with more improvements of the same order, and with partial success, from the

standpoint of the European climate as well as the demands of the limited compass then known. Allen and Thoms later on improved upon their first patent, but not before they had been anticipated in this country by Alpheus Babcock, a piano-maker of Boston, whose invention Jonas Chickering subsequently perfected. Probably it was the obvious inability of London-made pianos to stand our climate, or the intrinsic defects in the system of case-building then in vogue, which attracted the attention of American piano-makers as early as 1790, when cases were put together with screws instead of glue in Philadelphia; anyway, it has long been a subject of pardonable pride to American piano-makers to know that the problem referred to was solved in this country.

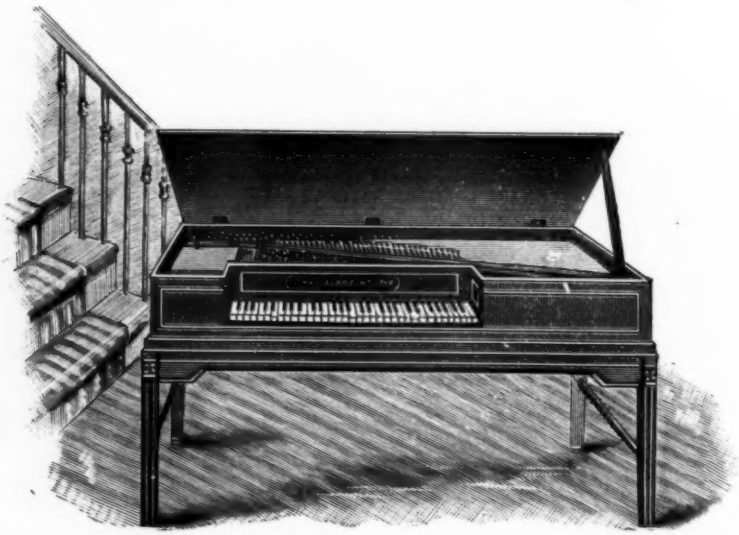

FIG. 11.—THE ALBRECHT PIANO, A. D. 1789. Pennsylvania Historical Society. Made in Philadelphia by Charles Albrecht. One of the oldest American pianos known.

In 1775 John Behrent, of Philadelphia, announced that "he had finished an extraordinary instrument by the name of the piano-forte in mahogany, in the manner of the harpsichord." This was probably the first piano made in America. James Julian came forward in 1784, when the Revolutionary War had just been concluded, and advertised the great "American piano-forte of his own invention." In 1789 a piano-forte made by George Ulshofer, a German musician and musical instrument maker and repairer, was exhibited by him in Corre's City Tavern, New York. Some time before this year Charles Albrecht began making pianos in Philadelphia, many notable specimens of which exist to-day. One stands in the Art Rooms of the Philadelphia Historical Society, dated 1789, and another was presented by the late Mr. Drexel to the New York Museum of Art.

I find a definite announcement in 1792, in the first number of the Diary or Lowdon's Register, of February 12th, in which Messrs. Dodds & Claus, musical instrument manufacturers, 66 Queen Street, announce the "*forte piano* of their make, with their own improvements."

Piano-manufacturing in New England was begun by Benjamin Crehore, in Boston, as early as 1798. He had a workshop at Milton, Mass., where he made violins and violoncellos many years previously, but his first piano was produced some time in that year. His workshop proved to be a national school for the art, so to speak, for Alpheus Babcock and John Osborn, the celebrated piano manufacturers of the period, with whom Jonas Chickering learned his business, were apprentices of Crehore's. The first Chickering, therefore, sprang indirectly from the latter's modest factory.

The pioneer makers in New York were Davis, Gibson, Kersing, and Geib—names now almost forgotten, although old instruments of their production may be found occasionally in piano ware-rooms and country houses. All of these were in business before 1800 and upward, but they never attained prominence or wealth.

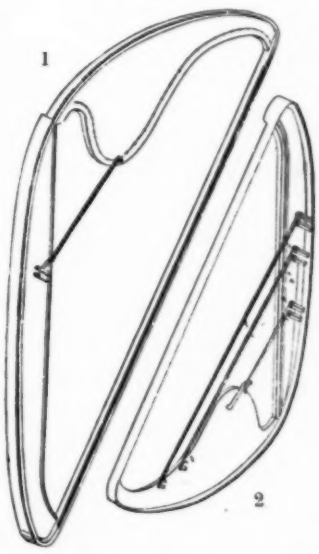

FIG. 12.—BABCOCK'S SKELETON IRON PLATES. 1. Patented December 17, 1825. 2. With iron ring, patented May 24, 1830.

The piano industry had attained some footing in America toward 1829, despite foreign competition, for in that year twenty-five hundred pianos were made here—nine hundred being produced in Philadelphia, eight hundred in New York, seven hundred and seventeen in Boston, and a considerable number in Baltimore and Cincinnati. At that period the Loud Brothers, of Philadelphia, were the leading American makers—a position assumed by Chickering & Mackay toward 1840. In Boston, Osborn, Jonas Chickering, and Alpheus Babcock were established—the former being one of the most distinguished of native piano-makers. Babcock, who produced and patented his skeleton iron plate in 1825, moved to Philadelphia in 1830, where he lived for a few years.

Jonas Chickering began business in 1823, in partnership with James Stewart, a practical piano-maker and inventor. Stewart had been previously in business in Baltimore, but came North to become a partner of Osborn, with whom he quarreled in a short time, when a separation ensued. In 1826 Stewart went to Lon-

don, having accepted a position as superintendent of Collard & Collard's. Mr. Chickering entered into partnership with a Captain Mackay at this juncture, and the new firm rapidly rose to a foremost place as makers of pianos, thanks to the inventive and technical genius of Mr. Chickering. In 1841 Captain Mackay died, when the whole business reverted to Chickering.

Jonas Chickering was born in Ipswich, N. H., April 5, 1798. He learned cabinet-making in his native town, and when a mere youth turned his face toward Boston, to find an outlet for his native abilities. On arriving in Boston he found his way into Osborn's shop, leaving it subsequently to enter on a successful career as a manufacturer and inventor. In 1840 he introduced and patented his full solid-cast metal plate for squares, which he carried into grands in 1842. The introduction of these plates marks an era in the history of the American piano.

FIG. 13.—JONAS CHICKERING.

Upon the death of Jonas Chickering, in 1853, the responsibilities of the business devolved upon his three sons—Thomas E., C. Frank, and George H. Chickering. The first two are dead, the last is the present head of the firm of Chickering & Sons. C. Frank Chickering, the author of the chief developments in the Chickering piano since his father's death, has left behind him a

splendid record as an inventor, while his most artistic labors have been performed in the region of acoustics, or tone development. He was born in Boston, June 26, 1827, where he received his education and professional training. He lived in New York for many years, attaining an influential position in social and artistic circles, and died here March 23, 1891. George H. Chickering was born in Boston, April 18, 1830. Trained under his father's eye in all departments of the art, he was eminently fitted for the province in which he labored up to the time of his brother's death, while time and experience have amply qualified him for the responsible position he now occupies.

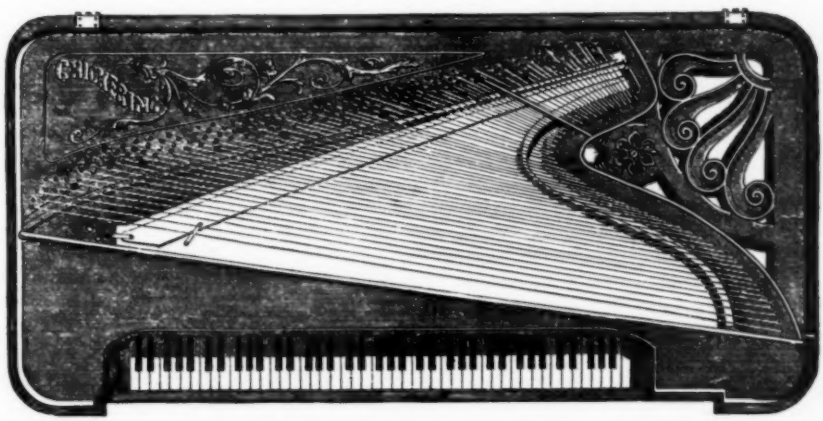

Fig. 14.—Chickering's Full Solid-cast Iron Frame, a. d. 1840. Also applied to Grands.

Chickering's "circular scale" for squares followed the full metal plate, and this became in later years a direct key to the development of the system of "overstringing" now in general use in this country. Previous to the "circular scale" the hammer heads struck upon an almost straight line throughout, and having, meanwhile, to conform to a standard law which regulates the part of the string on which the hammer is to strike, piano-makers were restricted from bringing forward further improvements in stringing and case structure. Jonas Chickering, however, helped to remove the barriers which impeded progress by running his hammer-heads on a curve. This permitted the introduction of many original features in the general constitution of the instrument, leading up to still greater developments. The improvement was suggested to Chickering by the perfecting of the plate idea, for, having found the latter to be a most satisfactory means of strengthening his cases so as to withstand all extra tension imposed by heavier stringing and an extension of the keyboard, he was placed in a position to move forward, and the "circular scale" for squares was the outcome. This system, however,

was never found applicable to the grand or upright, owing to their different construction, though the late C. F. Chickering took out a patent for a "circular scale" for the latter instrument in 1871.

The term "scale" in the technical vocabulary of the piano-maker means—superficially—the disposition of the strings; but it really means far more, for the scale draughtsman has to make radical changes in the case, action, structure of the plate, and other lesser features to correspond with any changes made in the arrangement or use of the strings. The Chickering "circular scale" is regarded as a most important contribution by old piano-makers, though it was never carried beyond the square.

Loud Brothers, of Philadelphia, had in the mean time brought out and patented many features of moment, which gave impulse to other thinkers, but nothing of consequence comparable with Chickering's achievements. New York makers were not slow to see the advantage of the latter's plates, which were copied in various forms. A few of the more ingenious managed to use plates almost similar to Chickering's, without exposing themselves to legal proceedings. The "circular scale," being an unpatentable species of innovation, was, however, freely copied.

The most notable of the makers in New York around the "fifties" were the Nunns family and Bacon & Raven. The former introduced the French square action into this country, and are known to have brought forward some minor improvements.

The next and most important advance in piano construction was overstringing. In the old system of stringing—which is yet in use among English makers—the strings throughout were placed almost parallel, in harp-fashion. In the illustration of a Chickering plate (Fig. 14), this method of string adjustment may be seen. British and French makers yet stick to the old system to some extent, though they have adopted many of the progressive traits of American pianos. Even the eminent house of Broadwood & Son, London, still use the "flat scaling," as it is called, in preference to overstringing, on the ground that it yields a purer quality of tone. This is only a matter of opinion, however, about which the best makers and experts of Germany and this country differ. One thing, meanwhile, is indisputable—viz., that English pianos lack the power and resonance of American instruments, and would never stand this climate. They are constructed for sweetness and daintiness of tone rather than for volume. American pianos, on the other hand, possess a remarkable combination of all those qualities which are in the highest sense related to musical art.

Overstringing was anticipated about the beginning of the century by the elder Thomas Loud, but nothing came of his experiments. Overstringing—which means simply the crossing of sec-

tions of the strings—was a difficult system to perfect, since it compelled radical changes in the disposition of the hammers, structure of the plate, and other component parts of the piano. About 1853, when the instrument had grown to still larger dimensions and power, thanks to the whole-cast metal plate, a point had been reached where it became apparent that further compass and volume of tone were impossible under accepted stringing conditions. Overstringing was the only avenue to further progress

FIG. 15.—HENRY E. STEINWAY.

in tone-development open to piano-makers; yet few saw it, and those who did were incapable of bringing it to a practical success. The chief points of superiority over the flat scaling are that overstringing permits the dividing up of the tensional pull of the strings upon the case, while it admits of their more advantageous use from the standpoint of tone, and renders the instrument more capable of staying in tune and up to pitch—a most important consideration.

John Jardine—a very clever piano-maker—was one of the earliest to attempt overstringing in this country, but his efforts led to no permanent results. Frederick Mathushek took out a pat-

ent for an application of this method of stringing in 1851, but it never became popular. Steinway & Sons, however, took up the idea in its crude stages a few years later, and applied it successfully. They not only developed overstringing, but it is to them we owe the improved disposition of the strings below. They were the first to exhibit a square piano containing a practical and successful development of the overstringing principle, which has since been accepted everywhere. An instrument made on these improved lines was exhibited at the American Institute Fair in 1855. It was awarded a gold medal, and was practically the parent instrument of that order, not only as regards the arrangement of the strings, but in the structure of the plate and most other general features. Bass overstringing, passing over three bridges, was a noticeable feature in that piano. A full metal plate, covering the wrest-plank, having a solid bar, was also used, with improvements which insured greater resistance against the pull of the strings. Another feature embodied in this instrument was the arrangement of the bridges. These were placed farther in on the sounding-board, so as to bring into sympathy hitherto dormant sections of its surface.

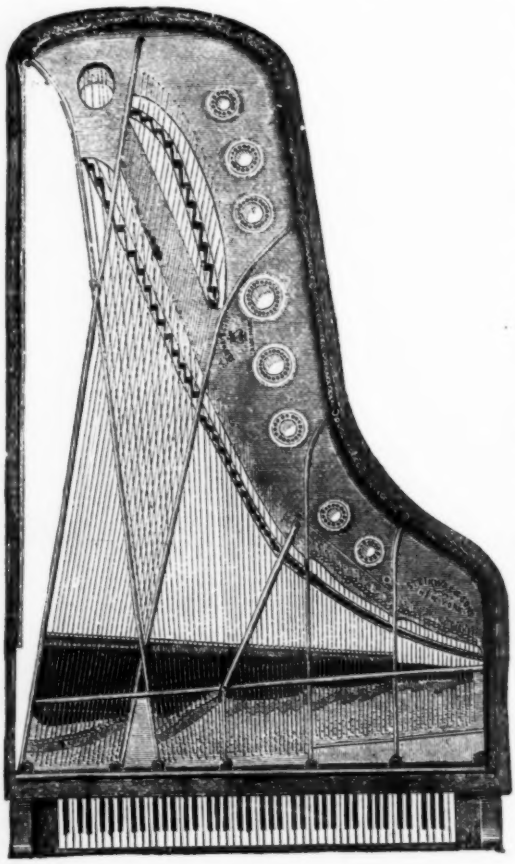

FIG. 16.—INTERIOR OF "STEINWAY" GRAND, SHOWING DISPOSITION OF THE STRINGS FAN-SHAPE.

Passing over the numerous inventions brought out by Steinway & Sons, following the success of their squares made on the system referred to, their patent for stringing in grands claims a brief notice. This is illustrated in Fig. 16. They were granted a patent for this invention in 1859. In the instruments made on the new lines the strings were spread out in fan-shape, in con-

junction with an original disposition of the bridges, as well as with a striking departure in the construction of the plate, the quality of wire used in the different sections throughout, and in many minor directions. The success of these instruments was pronounced, and the "Steinway" grands were immediately given a foremost place among the leading concert instruments of the world. In 1862 they applied overstringing on a full iron plate, together with many of the most significant features of their squares and grands, to the upright, a form little used in those times, though now holding popular favor to the almost entire exclusion of the square. Since that year they have added patent after patent, and have been most indefatigable in their efforts to improve the character of the piano. Among their other notable inventions must be named their "grand duplex scale," which is now adopted in all their improved instruments. This was introduced in 1872. Their modern grands are remarkable for the character of the action used, as much as for their individuality of tone. This action is a Steinway specialty, and contains many original and effective features, which render it capable of yielding remarkable results in the hands of the artist, the chief features being its power of quick repetition and susceptibility to artistic demands. This brief sketch of their inventions would be incomplete without mention of their "cupola metal frame." This is another improvement in the structure of the modern plate.

The house of Steinway & Sons was founded in 1853 by Henry E. Steinway and his sons, Charles and Henry. The elder Steinway was born in Wolfshagen, in the duchy of Brunswick, Germany, on December 17, 1797. From being an organ-builder he entered the sphere of piano-making at Seesen, where he married and began business on his own account. His three sons, C. Theodore, Charles, and William Steinway, were born at Seesen. Henry E. Steinway won a reputation as a progressive piano-maker from the beginning. In 1839 he exhibited a grand and two squares at the state fair of Brunswick, where he was awarded the prize medal by Albert Methfessel, the composer, who presided as chairman of the jury on the occasion. Meanwhile his sons all grew up in the atmosphere of the piano art business, in which they afterward figured so prominently. In 1850 Henry E. Steinway came to these shores on the advice of his son Charles, who had come over the year before to investigate the field. In 1853, the year of the first American World's Fair, the house of Steinway & Sons was founded. William, armed with an excellent education and a technical training, was taken into partnership late in that year, and since then has been closely identified with the growth of the business.

William Knabe, the founder of Knabe & Co., of Baltimore, whose portrait we give, was another important figure in the development of piano-making in America Born in Kreutzburg, Germany, in 1803, he came to this country twenty years later with a knowledge of piano-making; and, in association with Henry Gaehle, began manufacturing in Baltimore in 1839. A few years later he started in business for himself. Knabe was instrumental in bringing out many good "scales" and new ideas of similar unpatentable character, and is admitted to have left behind him a worthy record as a maker, being always identified with pianos of the first grade. He died in 1864 in Baltimore.

FIG. 17.—WILLIAM KNABE.

The late James A. Gray, of Boardman & Gray, of Albany, introduced several inventions of some moment into the square in past years, but with the decadence of that instrument their value ended.

William Lindeman, a native of Dresden, Saxony, and founder of Lindeman & Sons, introduced a "cycloid piano" in 1860, which won some notice from performers and experts. This instrument was a sort of compromise between the grand and square, but it was never a selling success, though a most meritorious and ingenious development.

Among other makers who identified themselves with the square during its popular period, may be named George Steck, John Jacob Decker, Andres Holmstrom, Myron A. Decker, Henry Hazelton, Napoleon J. Haines, and many others, living and dead, whose work in minor details can not be considered here.

The late Henry F. Miller, of Miller & Sons, Boston, and Albert Weber, founder of the eminent Weber firm, also deserve mention. The Miller and Weber firms played no insignificant part in improving the quality of American grands, and uprights as well. Henry F. Miller was a native of Providence, R. I., where he was born in 1825. He became an organist in early life, and subse-

quently drifted into piano-manufacturing in Boston, where he soon won a distinguished place.

The upright, although the popular form in Europe for over fifty years, never won a place here until past 1876, when the showing of these instruments at the Centennial Exhibition stimulated fresh efforts in this direction. About 1882 it had conquered the square as a household form of piano, and since then the latter has been fast going out of use. In fact, in the leading shops the manufacture of squares has ceased entirely.

Southwell's cabinet uprights, already spoken of, were large, clumsy instruments, though the first acceptable pianos in perpendicular shape produced. In 1812 Robert Wornum, a great figure in British piano-making records, brought forward an improved upright with diagonal strings, which, from its portableness and other characteristics, soon became the favorite. In his model the dimensions of the upright were reduced to about four feet six inches, and this subsequently in its improved features became the English cottage piano—a form still in popular favor in England. Wornum also produced a smaller upright in 1826, which he named the "piccolo." These, in addition to valuable action improvements, corresponding in effectiveness with the originality of his instruments, were most significant contributions to the development of the upright up to the latter date. He was also the inventor of the upright "tape-check action," which is now generally used, though with many modern improvements. It was patented in England in 1843, but, strange to say, despite its admitted qualities of excellence, was regarded with little favor in Wornum's own country, Continental piano manufacturers alone taking kindly to it. The upright, meanwhile, received much attention in Europe from piano-makers and improvers, and soon grew into popular favor, to the general exclusion of the square. The European squares, however, were never brought to any considerable degree of perfection, while American squares, on the contrary, were so excellent, toward 1860, that their musical and other qualities served to draw the attention of piano-makers from the upright. The demand for pianos taking little floor-space for household use in the large cities within more recent years drew the attention of makers to the upright as a substitute for the square; and, now that success has been achieved in giving the upright the musical characteristics of the square, the latter is almost out of date.

FIG. 18.—SECTION OF IMPROVED UPRIGHT ACTION.

Cabinets and other forms of uprights on English lines were

imported and made in this country about the time they came into use abroad. Timothy Gilbert, of Boston, introduced an improvement in the upright and its action in 1841, but it amounted to little. Jonas Chickering also paid some attention to the perfecting of the instrument, and many excellent uprights of his production may be found, but the public did not take kindly to them at the time. In addition to many minor inventions in the upright, he is said to have applied overstringing to them in 1851. But it was only after 1876 that the upright found any favor in this country.

The late C. Frank Chickering introduced some remarkable upright scales about 1870, having devoted much time and experiment to the perfecting of the instrument, and these were generally copied by competitors of less originality or spirit. Frederick Mathushek, previously mentioned, is also on record as having made some striking advances in the adaptation of the upright form to the popular demand. I have in mind the years preceding 1876. It would, however, be impossible to follow out in detail all the minor contributions made to the upright up to that year.

Excellent uprights are now manufactured by the leading firms, and in all may be found an average in the shape of improvements—the full iron plate in its most modernized form, overstringing with improved acoustic conditions, a good action well regulated, and almost every other feature that existing inventions warrant. But this is not to be interpreted as a declaration that further evolution is impossible. Meanwhile there are specialties in use in the instruments of some firms which I shall try to point out in a brief way. One of the most peculiar of these is the Mason & Hamlin system of tuning and stringing which they have introduced in all their pianos. Notwithstanding a disbelief freely expressed at the outset, their innovation has been, in fact, very successful. Instead of the conventional tuning-pin driven in a pin-block (known as the wrest-plank), they use a screw-headed blade, having a slot at one end for the string, and a screw at the other end by which it can be tightened. The principle is illustrated somewhat in a violin-bow. The blade runs in another slot to keep it from twisting, and the tension of the string is imposed upon a flange cast in the plate. This device is applied to their grands and uprights with most satisfactory results. Decker Brothers, Sohmer & Co., Steck & Co., Weber, Decker & Son, of New York, Hallett & Davis, Emerson Co., Miller & Sons, of Boston, and various other houses, also manufacture instruments with patented improvements, but though most of them are meritorious they are not revolutionary or striking. Behr Brothers, of New York, have, however, attracted much attention with-

in recent years through the introduction of an improved grand-action principle, and a system of stringing, which are illustrated. They are sparing no expense or pains in their efforts to improve the character of their instruments, and such sacrifices are entitled to acknowledgment. Their grand-action improvement assists the production of fine graduations of tone in performance as well as prompt repetition, while their method of string adjustment has been adopted with a view to rendering the instrument more capable of staying in tune, as well as for the purpose of tone development. This is applied to both uprights and grands.

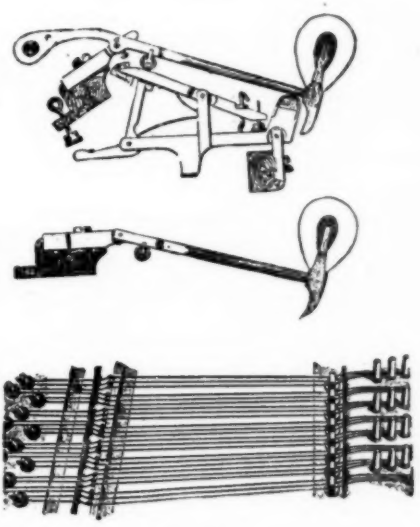

FIG. 19.

1. Behr Brothers' Grand Piano Hammer, with Compensating Lever.
2. Ordinary Hammer and Butt.
3. Behr Brothers' "Stringing Device." (All patented.)

James & Holmstrom, of New York, have recently patented and introduced a "transposing key-board" into their uprights, which is receiving considerable notice from artists. It is an ingenious adaptation of the ordinary key-board, by which the piano-performer may change the pitch at pleasure. Though the idea was anticipated a century ago, and frequently experimented with, it was reserved for Mr. Andres Holmstrom, of the above firm, to apply it with success. It is a great boon to vocalists and artists generally, and of popular value as well. In the invention referred to, the key-board, which is distinct from the action, is made to move a little toward either side, so as to bring the keys under different hammers; the performer is meanwhile given easy and effective control over its disposition, and variations of pitch can be obtained with ease. Apart from this invention Mr. Holmstrom has drawn many excellent upright "scales," which have given him a high reputation among piano-makers.

Conover Brothers, of New York, have also patented several inventions of much significance, the author of which is Mr. C. F. Conover, one of the most remarkable of the later-day school of makers. These cover improvements in almost every department of the upright instrument. They include an original tuning-pin arrangement, a method for obtaining prompt repetition in the

action, and a "scale" of especial moment and value. The latter also embraces a departure in plate construction as a part of the whole scheme. Conover's scale contains "duplex bridges" and what are termed "auxiliary vibrators," and in effect is a most meritorious contribution to American piano-making. Their "hollow steel" tuning-pin system is also a significant improvement, while their action is, as far as it is original, equally successful.

Steck & Co., and Decker Brothers, of New York, have been identified with the bringing out of several valuable improvements, which they use as specialties, the most important of which are in the form of scales which can not well be exemplified. The same remark applies to the specialties of several other houses, such as Haines Brothers, Hazleton Brothers, Decker & Son, Kranich & Bach, and others.

Meanwhile I can not pass over the inventions of Paul G. Mehlin, who has done much for the improvement of the modern piano. Though these are numerous and touch every region in the upright piano, his "grand plate and scale" for uprights deserves mention. Through it Mr. Mehlin claims to give the upright some of the principal characteristics of the grand, and the trial to a large extent justifies the claim. The Century Company, of Indianapolis, manufacture the "Mehlin pianos." Mr. Mehlin has taken out a considerable number of patents for improvements in the plate, wrest-plank, action, key-board, scaling, cases, and every section of the instrument since 1872, and has applications pending for more.

Henry Kroeger, of Gildemeester & Kroeger, has also been active as an improver, though his patented inventions cover no radical departures; but his contributions in the form of "scales"

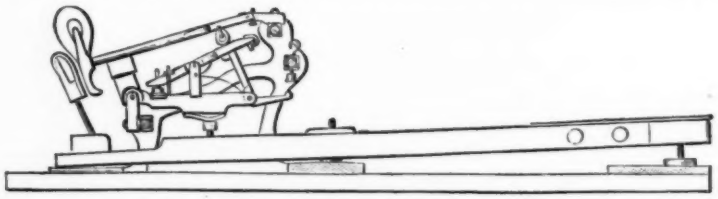

FIG. 20.—STEINWAY & SONS' GRAND REPETITION ACTION, WITH TUBULAR METALLIC FRAME. Patented October 20, 1875.

have been very useful, and during his career he has always been associated with the production of pianos of the highest class. His eminent services deserve this acknowledgment at least. Many other thinkers and inventors, such as Stephen Bramback, of the Estey Piano Company; Myron A. Decker, of Decker & Son; and Hugo Sohmer, of Sohmer & Co., are equally entitled to recognition, though limitations of space prevent more than their mention.

KINDRED INDUSTRIES.—Since 1850 the specializing of such

branches of piano-making as action and key making, and the casting of plates—apart from hammer making and covering, case-making, string and felt making—have helped the general development of the piano to a large extent. Action-making is the largest of all these branches. Formerly a skilled workman was expected to be competent in action-making and half a dozen other branches now separated. While the present system tends to prevent the coming to the surface of such skilled piano-makers as those who built up the principal houses now in existence, and otherwise confines the energies and intellect of clever young men in a narrow channel, yet the existing order of things is on the whole beneficent and better than the old.

The first action-making establishment in New York, and probably in the country, was opened by Andrew Brunet, an Alsatian, in 1841, in Clark Street. His place was very small and unpretentious. He was successful, for small manufacturers saw at a glance the advantages of being able to procure their actions from a specialist. Other establishments sprang up in a short time. While there are numerous small shops throughout New England and in the West, New York is the center for the production of the best class of actions; but Chickering & Sons, Boston, Steinway & Sons, Knabe & Co., Baltimore and New York, and a few other firms, produce their own. The two leaders in this branch of the business are Strauch Brothers and Wessell, Nickel & Gross, of New York. Both firms are engaged in a healthy rivalry for the first place in production and in quality of work, and many technical improvements have resulted from this condition of affairs. They both produce actions involving the same principles, but differing in minor details. Keys are also manufactured specially in New York and outside for the trade.

The production of plates for pianos comes next in importance to action-making. The first foundrymen to become identified with this specialty were the Shrivers, well known in that connection. To-day Shriver & Co., of New York, and Davenport & Tracey, of Stamford, Conn., control the largest proportion of the business.

The wonderful growth and extent of piano manufacturing in America is further illustrated in the business established and conducted by Mr. Alfred Dolge, the well-known initiator of the Dolge system of profit-sharing for employés. In the regions of sounding-boards, felts for hammer-heads and other purposes, and a host of incidental articles, he stands alone. In Dolgeville, a large town he has founded in the northern part of this State, he employs over six hundred hands in his felt and sounding-board factories, and has other establishments in Leipsic, Otterlake, and Port Leyden. Over 35,000 boards were turned out from this factory during the last year. For this purpose 2,800,000 feet of choice lumber were

handled. As each sounding-board represents a piano, one can easily estimate from this basis of observation alone the wonderful dimensions of the piano trade. The unique business in Dolgeville is well worthy of study as a curious example of American industrial life. Its relation to the piano industry is apparent.

In 1850 there were 204 establishments in this country making musical instruments; piano-fortes were not separately reported upon; 2,307 hands were employed, and the product represented $2,580,715. We find that in 1860 21,797 pianos, representing $6,548,432, were manufactured in the United States. The annexed table of statistics shows the industry in 1880, and is the latest:

State.	No. of establishments.	Capital.	No. of workmen.	Wages paid.	Cost of materials.	Value of products.
New York	82	$6,627,845	3,966	$3,213,481	$3,579,131	$8,084,154
Massachusetts	45	1,905,700	1,504	890,721	1,132,847	2,652,856
Maryland	4	638,382	385	200,988	157,699	534,099
Connecticut	3	257,000	302	142,057	182,018	386,583
Pennsylvania	5	169,500	154	87,044	81,145	217,924
Indiana	2	77,000	90	42,500	43,000	109,000
California	6	50,000	27	18,425	41,725	92,700
Kentucky	5	40,700	26	12,833	13,800	42,200
Illinois	5	20,360	27	16,902	11,800	37,675
New Hampshire	3	18,000	32	8,894	15,994	30,380
Missouri	7	21,350	19	10,398	8,060	27,200
Ohio	1	15,000	20	6,000	3,000	15,000
New Jersey	2	10,200	7	4,500	6,000	13,000
Wisconsin	2	10,600	10	4,250	4,500	12,570
Michigan	1	4,000	4	2,200	1,500	5,500
Texas	1	4,000	2	2,000	900	3,500
1880	174	$9,869,577	6,565	$4,663,193	$5,283,119	$12,264,521

When the statistics for 1890 appear, it will be found that the increase in production has been even larger in proportion during the last ten years.

"However prophetic," says Mr. A. H. Green in Nature, "may have been the far-seeing premonition of men in advance of their age in the dim past, and however invaluable may have been the additions made to the superstructure since, it can scarcely be doubted that the foundation-stones of geology were laid by Scotchmen and Englishmen toward the end of the last and during the earlier part of the present century. And what a charm there is about the story of those sturdy pioneers—not perhaps quite the men whom one would have picked out as most fitted or most likely to become the fathers of a new science! It has about it the elements of a genuine romance. For the early training of few of these men was such as to give a scientific bent to their mind; they did not have what we are pleased to call 'the advantage of a scientific education'; it is probable that they never spoke, perhaps never dreamed of such a phrase as 'the scientific method,' which we are so fond of formularizing, and on which we plume ourselves somewhat. But in spite of these seeming drawbacks, rather perhaps because with these men genius was allowed to run its spontaneous, untrammeled course, they opened out to mankind a domain of knowledge, the very outskirts of which had been barely touched upon before.

ELECTRICITY IN RELATION TO SCIENCE.*

By Prof. WILLIAM CROOKES.

THE third annual dinner of the Institution of Electrical Engineers was held at the Criterion on Friday, November 13th. Prof. William Crookes, the president, was in the chair. In proposing the toast of the evening, "Electricity in relation to Science," Prof. Crookes delivered the following speech:

We have happily outgrown the preposterous notion that research in any department of science is mere waste of time. It is now generally admitted that pure science, irrespective of practical applications, benefits both the investigator himself and greatly enriches the community. "It blesseth him that gives, and him that takes." Between the frog's leg quivering on Galvani's work-table and the successful telegraph or telephone there exists a direct filiation. Without the one we could not have the other.

We know little as yet concerning the mighty agency of electricity. "Substantialists" tell us it is a kind of matter. Others view it, not as matter, but as a form of energy. Others, again, reject both these views. Prof. Lodge considers it "a form, or rather a mode of manifestation, of the ether." Prof. Nikola Tesla demurs to the view of Prof. Lodge, but thinks that "nothing stands in the way of our calling electricity ether associated with matter, or bound ether." Higher authorities can not even yet agree whether we have one electricity or two opposite electricities. The only way to tackle the difficulty is to persevere in experiment and observation. If we never learn what electricity is, if, like life or like matter, it should remain an unknown quantity, we shall assuredly discover more about its attributes and its functions.

The light which the study of electricity throws upon a variety of chemical phenomena—witnessed alike in our little laboratories and in the vast laboratories of the earth and the sun—can not be overlooked. The old electro-chemical theory of Berzelius is superseded, and a new and wider theory is opening out. The facts of electrolysis are by no means either completely detected or coordinated. They point to the great probability that electricity is atomic, that an electrical atom is as definite a quantity as a chemical atom. The electrical attraction between two chemical atoms being a trillion times greater than gravitational attraction is

* Speech delivered at the third annual dinner of the Institution of Electrical Engineers, London, November 13, 1891.

probably the force with which chemistry is most deeply concerned.

It has been computed that in a single cubic foot of the ether which fills all space there are locked up ten thousand foot-tons of energy which have hitherto escaped notice. To unlock this boundless store and subdue it to the service of man is a task which awaits the electrician of the future. The latest researches give well-founded hopes that this vast storehouse of power is not hopelessly inaccessible. Up to the present time we have been acquainted with only a very narrow range of ethereal vibrations, from extreme red on the one side to ultra-violet on the other—say from three ten-millionths of a millimetre to eight ten-millionths of a millimetre. Within this comparatively limited range of ethereal vibrations, and the equally narrow range of sound vibrations, we have been hitherto limited to receive and communicate all the knowledge which we share with other rational beings. Whether vibrations of the ether, slower than those which affect us as light, may not be constantly at work around us, we have until lately never seriously inquired. But the researches of Lodge in England, and Hertz in Germany, give us an almost infinite range of ethereal vibrations or electrical rays, from wave-lengths of thousands of miles down to a few feet. Here is unfolded to us a new and astonishing universe—one which it is hard to conceive should be powerless to transmit and impart intelligence.

Experimentalists are reducing the wave-lengths of the electrical rays. With every diminution in size of the apparatus the wave-lengths get shorter, and could we construct Leyden jars of molecular dimensions the rays might fall within the narrow limits of visibility. We do not yet know how the molecule could be got to act as a Leyden jar; yet it is not improbable that the discontinuous phosphorescent light emitted from certain of the rare earths, when excited by a high-tension current in a high vacuum, is really an artificial production of these electrical rays, sufficiently short to affect our organs of sight. If such a light could be produced more easily and more regularly, it would be far more economical than light from a flame or from the arc, as very little of the energy in play is expended in the form of heat-rays. Of such production of light, Nature supplies us with examples in the glow-worm and the fire-flies. Their light, though sufficiently energetic to be seen at a considerable distance, is accompanied by no liberation of heat capable of detection by our most delicate instruments.

By means of currents alternating with very high frequency, Prof. Nikola Tesla has succeeded in passing by induction through the glass of a lamp energy sufficient to keep a filament in a state of incandescence without the use of connecting wires. He has

even lighted a room by producing in it such a condition that an illuminating appliance may be placed anywhere and lighted without being electrically connected with anything. He has produced the required condition by creating in the room a powerful electrostatic field alternating very rapidly. He suspends two sheets of metal, each connected with one of the terminals of the coil. If an exhausted tube is carried anywhere between these sheets, or placed anywhere, it remains always luminous.

The extent to which this method of illumination may be practically available experiments alone can decide. In any case, our insight into the possibilities of static electricity has been extended, and the ordinary electric machine will cease to be regarded as a mere toy.

Alternating currents have at the best a rather doubtful reputation. But it follows from Tesla's researches that as the rapidity of the alternation increases they become not more dangerous but less so. It further appears that a true flame can now be produced without chemical aid—a flame which yields light and heat without the consumption of material and without any chemical process. To this end we require improved methods for producing excessively frequent alternations and enormous potentials. Shall we be able to obtain these by tapping the ether? If so, we may view the prospective exhaustion of our coal-fields with indifference; we shall at once solve the smoke question, and thus dissolve all possible coal rings.

Electricity seems destined to annex the whole field, not merely of optics, but probably also of thermotics.

Rays of light will not pass through a wall, nor, as we know only too well, through a dense fog. But electrical rays of a foot or two wave-length of which we have spoken will easily pierce such mediums, which for them will be transparent.

Another tempting field for research, scarcely yet attacked by pioneers, awaits exploration. I allude to the mutual action of electricity and life. No sound man of science indorses the assertion that "electricity is life"; nor can we even venture to speak of life as one of the varieties or manifestations of energy. Nevertheless, electricity has an important influence upon vital phenomena, and is in turn set in action by the living being—animal or vegetable. We have electric fishes—one of them the prototype of the torpedo of modern warfare. There is the electric slug which used to be met with in gardens and roads about Hornsey Rise; there is also an electric centiped. In the study of such facts and such relations the scientific electrician has before him an almost infinite field of inquiry.

The slower vibrations to which I have referred reveal the bewildering possibility of telegraphy without wires, posts, cables, or

any of our present costly appliances. It is vain to attempt to picture the marvels of the future. Progress, as Dean Swift observed, may be too fast for endurance. Sufficient for this generation are the wonders thereof.—*Nature.*

THE NATIONALIZATION OF UNIVERSITY EXTENSION.

By Prof. C. HANFORD HENDERSON.

I HAVE read with attention the editorial comment on university extension, published in the November number of this magazine, and I am glad to see the subject given so much prominence. The movement has still much of the plasticity of youth, and any discussion regarding its proper ends and aims, or of the means by which these are to be gained, can never be more helpful than now. The present opportunity, it seems to me, is a very large one, and we need the fullest and most impersonal play of thought upon all questions connected with the extension scheme. It is with this feeling in mind that I welcome most heartily the editorial dissent from the proposition to make the work a national activity. The proposition is assuredly a grave one, not only as regards university extension, but even more because it involves a distinct principle of governmental policy, which is either to be courted or to be shunned.

If I may ask for a little further space, I should like to add a word concerning this proposition, which, it is needless to say, was not lightly made. And I should like to speak again, not so much in defense of the proposition—for one must not, in such an inquiry, allow one's self the attitude of an advocate—as to point out that there is another way of looking at national co-operation with university extension than as a subsidy for the movement. And I am the more ready to speak, because it seems to me that perhaps the editorial dissent is not so much against the proposition actually made in the article under discussion, as against a proposition which *might* have been made, and was not, but which presented itself to the mind of the critic as he read.

It is objected that university extension must depend for its success upon individual zeal and public spirit—to which, of course, I fully agree—and that government aid would defeat this purpose. But such a result is by no means necessary. It would depend entirely upon the way in which the aid was given. At present, university extension centers are established quite by private action, and the societies for the extension of university teaching simply co-operate with the local center in providing lecturers, issuing syllabi, and the like. The local center, be it remembered, meets

all its own direct expenses. But the central office must meanwhile be sustained. At present this is done in most cases by private subscription. It is a benefaction, and bounded by all the limitations of a benefaction. Under this arrangement it is quite clear that a center can only be established where there are people of means willing to make themselves responsible for the local expense in case the sale of lecture tickets does not provide sufficient funds. The freedom of the individual to avail himself of university extension is, therefore, limited by the double contingency of local conditions and the facilities possessed by the nearest central office. In no case, it is to be observed, does the central office suggest courses, or pay for them.

Now, it was not proposed that Government should assume the paternal duty of establishing lecture courses in the arts and sciences here and there over the country, like so many intellectual post-offices. But it was proposed that the establishment of local centers should be left, as now, to private initiative and enterprise, while the Government should simply assume the duties of the central offices on a larger and more liberal scale. The work promises to be much too large for private enterprise, and since it does not pay for itself, it can not, in private hands, be thoroughly and systematically done with regard to the country at large. The movement would not be pauperized or degraded by such nationalization. There would be the same play for individual zeal and public spirit as now. But there would be this difference: it would everywhere find established and adequate co-operation where now it finds only special and metropolitan co-operation.

I think that the experiment would not be very dangerous, and it need not be very expensive. Once established, these district central offices of the Department of Education might with perfect propriety go a step further, and provide, under suitable conditions, for part of the expense of an extension course where the proceeds from the sales of lecture tickets were not sufficient. With the people themselves directly creating each center, electing their own subject, choosing their own lecturer, and paying for all or part of the local expense, I really do not see how the movement could become commonplace or mercenary in its character by being systematized under national auspices. There would be room here for an enthusiasm which could be followed by performance.

Like most lovers of freedom we are often too jealous of it to use it. The chief incapacity for greatness in republican administrations is that we are at heart cowards. We make our own government, and are then very much afraid of it. It is as if we feared that this thing which we have ourselves created should turn and devour us; and this distrust is everywhere fostered by the current belief that American politics is very corrupt. Un-

doubtedly it is corrupt, but it will well bear comparison with the activities of private life, with banking and mining enterprises, with railroads and telegraphs, with buying and selling. An impartial review of American history during the decade just passed will disclose a remarkable result, and one which deserves emphasis here and elsewhere:

The sum of American public infamy is neither absolutely nor relatively so great as the sum of American private infamy.

On all sides we hear the reverse. It is preached to us from pulpit and from press, for the human mind has ever shown a willingness for that light gymnastic which consists in setting up a man of straw and then knocking him down. It is better to face the truth. Our Government is corrupt only because our society is corrupt, and it is less corrupt than society because vice is a mortal coward and never does its worst in the open. The electric light has much increased the morality of large cities. The necessary publicity of national action does not insure honesty, but at least it prevents much dishonesty. In those departments in which the Government does attempt to serve us in a positive capacity, such as the Post-Office, the Coast Survey, the Smithsonian, the Geological Survey, the Weather Bureau, the Department of Agriculture, and the like, the service is certainly truer and more effective than parallels from private corporations. I know that Mr. Gould says that the mails would be better administered as private enterprise, but the history of the Western Union Telegraph Company hardly bears out the remark. In view of the experience of the nation, I do not think that university extension need fear corruption should it be included in the portfolio of the incoming Secretary of Education.

Nor is it by any means a proved case that there is a paralyzing lack of vitality in our public schools. It is often asserted, but, taking America as a whole, it seems to me that they are very much alive. It is true that they are commonplace, so commonplace indeed that a conscientious educator will often ask himself whether he should consent to such a system, and will hesitate as to whether he should not withdraw from the public service. But if he will look around him he will see that they are the schools of a commonplace community, and are as good as the community will tolerate. Even in Boston, Alcott's Temple School could not live. One must admit that the public schools are in many ways deplorable tread-mills, and that there are serious scandals in their administration; but they also will well bear comparison with private institutions. They have, moreover, this great advantage, that they permit a freedom and honesty of expression not always tolerated in those institutions which hang for support upon private pocket-books and prejudices. In judging of our public schools

we must always bear in mind their constituency. They are the schools of the populace as well as of the higher classes. If we take the attitude of mind of the average American citizen and compare it with the standards of life represented by the public schools, and then take the culture of the educated classes and compare it with the ideals set forth by private institutions, we shall find that, relatively speaking, the public schools are on much the higher plane; and surely no other mode of comparison can commend itself to our sense of fairness. Instead, therefore, of mistrusting the lesson of the public schools, I should be glad to believe that in five years—no, in ten years—university extension would be doing *in its line* as effective work as our poor commonplace public schools are doing in theirs.

I have tried briefly to answer the expressed objections to the nationalization of university extension; but these do not represent to me the gravest of the possible objections which might be urged, and I am also disposed to believe that under the editorial comment there was a more fundamental dissent in mind. The question, I take it, is essentially not one of experience as to what sort of a servant the Government has been in the past, but is the deeper question of the proper function of government. Had experience shown the public service to be relatively poor instead of being, as I believe, relatively good, I should still advocate its ministration if social studies led to the conclusion that public serving was desirable. The remedy would then lie, not in abolishing the service, but in purifying it. On the other hand, had experience been most favorable, more favorable by far than it has been, and could it be shown on sound theoretical grounds that such governmental activity was mischievous and likely to lead to encroachments upon ultimate personal liberty, it would be one's clear duty to set one's self resolutely against the public convenience and abolish such dangerous service.

Speaking in a large way, there are in America to-day two classes of political thinkers: those who believe in a paternal government, which shall say what one shall eat and drink, what one shall wear, how long one shall work, at what age one shall send one's children to school, what precautions one shall take against loss of life—in a word, a government which shall be a special if not always a very wise providence to each of its citizens; and there are those who, mistrusting this meddlesome paternalism, would go to the other extreme, and would limit the functions of Government to a minimum. The first class is apt to include those well-meaning but mischievous reformers who wish, like the prohibitionist, to cure society by medicine in place of hygiene, and that part of our professional class who have drawn their social ideals from bureaucratic Germany. The second class

takes in those, perhaps, who have studied the political writings of Herbert Spencer, and have translated his sturdy and wholesome demands for the largest possible individual liberty to require a perpetually negative attitude on the part of the Government.

It is difficult to say which class, if left to itself, would make America the more unendurable.

It is this question of our ideal of government which is involved in the proposed nationalization of university extension, and not a mere question of past or probable experience.

This opens one of the most profound problems in our American political life, and one which may be stated indeed but scarcely discussed within such brief limits as the present. Yet feeling that the issue under discussion has its solution in the solution of this larger question, I can not refrain from calling attention to the very doubtful character of the liberty which is to be enjoyed under a *régime* of social and governmental negations. Writers of the sentimental school of political economy—a school which oddly enough includes many prosaic labor agitators of the present day—fairly gloat over their picture of the ideal liberty enjoyed by man in his pre-social existence. But there are many who can feel no enthusiasm for this impossible picture. Place a naked man on an island in the Pacific, and, however generous Nature may be, however free he may be from the tyrannies of modern society, it would be the worst mockery to speak of him as enjoying liberty, for liberty, as a man of any imagination must perceive, presupposes not only the absence of restrictions upon individual action, but also the presence of certain conditions which will make those desired actions possible. In a word, *liberty is a positive and not a negative condition.* Again I venture upon the use of Italics to emphasize what seems to me a most important truth. When we contemplate the narrowing and annoying restrictions which the holders of the ideal of a paternal government would impose upon American life—the eternal *thou shalts* and *thou shalt nots* of prohibitionists and dictators of all classes—the temptation is to swing to the opposite extreme of the pendulum, and declare that absolute non-interference on the part of Government is the only safeguard. When, further, one reads Herbert Spencer's admirable volume on Justice—admirable, that is to say, excepting his unfortunate utterances on the status of woman in the state—one is, at first, confirmed in this negative retreat. The sole function of Government is to insure the greatest possible individual liberty consistent with the liberty of all. This is the conclusion which one of the most profound thinkers of the century reaches at the end of a long and thought-crowded life. And one could ask for no better definition. But how is this conclusion to be applied? That is the question. There is a tend-

ency, it seems to me, on the American side of the Atlantic, to misinterpret this principle, and to discredit too much the immense power for good in proper governmental activity. And even Herbert Spencer himself, gazing too steadily upon the slavery of socialism and the mischief of protection and prohibition, warrants in a measure such a misinterpretation. It is true that governmental activity run wild is as harmful as a thunderbolt, but, when chained to the right sort of service, it is as useful as the electric current. It is possible to apply the salutary principle laid down in the volume on Justice in a manner that will avoid the evils of both paternalism and of too great passivity. Nor is this playing with fire. The line between legitimate and illegitimate governmental activity is easily drawn. What is mandatory in government must not much exceed the Decalogue, or it trespasses on that individual liberty which it is the sole function of government to promote. But the field of action is not so narrow as this. There is a large region of what may be called permissives, in which an intelligent Government may with perfect propriety make individual actions possible, which would otherwise be quite impracticable, and this is very different from the spirit of the Decalogue. Every free Government does at the present time extend a large measure of mere verbal permission to its citizens, but this is rather a gratuitous bit of graciousness, if it do nothing to see that adequate means are obtainable.

We have, then, an easily applied test of the propriety of any governmental action. If it compel, beyond the primal social necessaries—the prevention of murder, theft, adultery, and the like—it is mischievous, and is to be resisted as an encroachment upon individual liberty. But if it render intelligent assistance in making desirable individual action possible, it is to be hailed as a legitimate extension of individual liberty, and is to be utilized as a fruit of the progress of civilization in precisely the same spirit that we would utilize the inventions of Siemens or Edison. One is free, for instance, to write a letter to any one in any place, but he is the more free in that Government delivers it for him at a cost so small that the very poorest may write. There is much that is most desirable to be accomplished in America through national action, and it seems to me that we cheat ourselves sadly if we hesitate to use so powerful a means out of fear that it shall be misused. The more it is properly used, the better will its function be understood, and the less likely to be abused.

Viewing the function of Government in this light, I still believe that the nationalization of university extension is highly desirable, for I believe that, by supplying adequate means for the carrying out of a great idea, it would add immensely to that indi-

vidual liberty which it is the special province of Government to conserve, and this, too, without any loss of individual zeal and initiative.

Let us repeat it: A governmental activity which compels, is mischievous; an activity which says: "Thou mayst; lo, here are the means," is helpful.

IS MAN THE ONLY REASONER?

By JAMES SULLY.

THE "whirligig of time" may be said to be bringing to the much-neglected brutes an ample revenge. The first *naïve* view of the animal mind entertained by the savage and the child is a respectful one, and may perhaps be roughly summed up in the formula in which a little boy once set forth his estimate of equine intelligence: "All horses know some things that people don't know, and some horses know more things than a great many people." But this pristine unsophisticated view of the animal world, though its survival may be traced in mythology and religious custom, has long since been scouted by philosophers. Thinkers, from Plato downward, have, not unnaturally perhaps, regarded the faculty of rational thought, which they themselves exhibited in the highest degree, as the distinguishing prerogative of man. The Christian religion, too, with its doctrine of immortality for man and for man alone, has confirmed the tendency to put the animal mind as far below the human as possible. And so we find Descartes setting forth the hypothesis that animals are unthinking automata.

Not forever, however, was the animal world to suffer this indignity at the hands of man. Thinkers themselves prepared the way for a *rapprochement* between the two. More particularly the English philosophers from Locke onward, together with their French followers, pursuing their modest task of tracing back our most abstract ideas to impressions of sense, may be said by a sort of leveling-down process to have favored the idea of a mental kinship between man and brute. This work of the philosophers has been supplemented by the leveling-up work of the modern biologist. There is not the least doubt that the wide and accurate observation of animal habits by the naturalists of the last century has tended to raise very greatly our estimate of their mental powers. So that it would seem as if in the estimation of animal intelligence, scientific knowledge is coming round to the opinion of the vulgar, and as if "the conviction which forces itself upon the stupid and the ignorant, is fortified by the reasonings of the in-

telligent, and has its foundation deepened by every increase of knowledge."*

Definiteness has been given to the question of the nature of animal intelligence by the new doctrine of evolution. If man is descended from some lower organic form, we ought to be able to make out not merely a physical but a psychical kinship between him and the lower creation; and the more favorable estimate of the animal mind taken by the modern *savant* is of great assistance here. Mr. Darwin has, indeed, shown in his valuable contributions to the subject, that the rude germ of all the more characteristic features of the human mind may be discovered in animals. At the same time, Mr. Darwin's investigations in this direction amounted only to a beginning. The crux of the evolutionist, the tracing of the continuity of crude, formless animal inference, up to the highest structural developments of logical or conceptual thought, still remained. And so, the most powerful attack on the theory of man's descent has come from the philosopher, the logician, and the metaphysical philologist, who have combined to urge the old argument that conceptual thought indissolubly bound up with language sets an impassable barrier between man and brute.

Mr. Darwin's unfinished work has now been taken up by one who adds to the biological knowledge of the expert a considerable acquaintance with psychology. In his previous volume, Mental Evolution in Animals, Dr. Romanes took a careful psychological survey of the animal world for the purpose of tracing out the successive grades of its mental life. In his recent volume, Mental Evolution in Man (Origin of Human Faculty), he essays to trace forward this general movement of mental evolution to the point where logical reasoning or "conceptual thought" may be distinctly seen to emerge. That is to say, he adroitly seeks to leap the "impassable" barrier by merely denying its existence. Human reasoning and animal inference are not two widely dissimilar modes of intellection. The one is merely a more complex expansion of the other. If you start either at the human or the animal bank you can pass to the opposite one by a series of stepping-stones. In other words, the higher human product can be seen to have been evolved out of the lower by a continuous process of growth.

Dr. Romanes's present contribution to the theory of evolution is thus emphatically the construction of hypothetical stepping-stones for the purpose of passing smoothly from the territory of animal to that of human reasoning. In order to this, he has on the one hand to follow up animal intellection to its most note-

* Prof. Huxley, Hume, p. 104.

worthy achievements, and on the other hand to trace the process of human intellection down to its crudest forms in the individual and in the race.

As it is obviously language which marks off human thought from its analogue in the animal world, our author is naturally concerned to limit the function of language. While allowing as a matter of course that the "conceptual thought" of the logician involves language as its proper instrument or vehicle, he urges that there is a good deal of rudimentary generalizing prior to, and therefore independent of, language. To establish this a careful examination of the higher processes of animal "ideation" has to be carried out. In doing this Dr. Romanes introduces a number of psychological distinctions of a somewhat technical kind. Of these the most important perhaps is that between the time-honored *concept* of the logician and the *recept*. This last corresponds to Mr. Galton's generic image or the common image (*Gemeinbild*) of the German psychologists. It is an image formed out of a number of slightly dissimilar percepts corresponding to different members of a narrow concrete class, such as dog or water. According to our author, animal reasoning remains on the plane of recepts. It is carried on by pictorial representations. At the same time it involves a process of classification or generalizing. A diving-bird must be supposed to have a generalized idea (recept) of water, a dog a generalized idea of man, and so forth. Nay, more, this receptual ideation enables the animal to reach "unperceived abstractions," as the idea of the quality of hollowness in the ground, and even "generic ideas of *principles*," as when the writer's own monkey having discovered the way to take the handle out of the hearth-brush by unscrewing it, proceeded to apply the principle of the screw to the fire-irons, bell-handle, etc.

The author's whole account of this receptual ideation or the logic of recepts is interesting and persuasive. He has, it must be owned, clearly made out the existence of a very creditable power among animals of carrying out processes analogous to our own reasonings without any aid from language. Yet a doubt may be entertained whether the author has really got at the bottom of these mental feats. The whole account of the recept is a little unsatisfactory, owing to the circumstance that the writer does not make it quite clear in what sense it involves generalization. He writes in some places as if the fact of the generic image having been formed out of a number of percepts corresponding to different members of a class, e. g., different sheets of water seen by the diving-bird, gives it a general representative character. But this, as indeed Dr. Romanes himself appears to recognize in other places, is by no means a necessary consequence. A generic image may form itself more readily than a particular one, just

because the animal is unable to note differences sufficiently to distinguish one sheet of water or one man from another. A baby's application of the common epithet "dada" to all bearded persons suggests not that it is carrying out any process of conscious generalization, but rather that it is failing to discriminate where there are striking and interesting features of similarity. It would seem as if an idea only acquires a properly general function after certain higher intellectual processes have been carried out. These may be roughly described as the active manipulation of percepts and images, by analytical resolution of these into their constituent features, and a due relating or ordering of these elements. Only in this way does it appear possible to reach a rudimentary form of a properly *general* notion; that is to say, an idea which is consciously apprehended as representing common features among a number of distinct objects. Mere superposition of images may result in a new typical image; but the mind in which such an image forms itself can not know this to be generic or general till these processes which underlie active thought have been carried out. Now, we ourselves carry out these operations of resolving into elements and recombining these elements (analysis and synthesis) largely by the help of class-symbols or general names, which come to be general symbols just because we make use of them for the purpose of noting down and keeping distinct the results of our successive comparisons and analyses. And the really pressing question for the evolutional psychologist is, How does this manipulation of the mind's imagery get carried out where the serviceable instrument of language is absent? That it does get carried out to some extent may be readily allowed. A sagacious and well-bred collie, who combines with a judicious preference for his owner a certain mild complacency toward mankind at large (with some possible exceptions), may be rightly regarded as having attained to a rudimentary consciousness of the distinction between the general and the particular, the "class" and its constituent members. But how this has been attained Dr. Romanes's account of receptual ideation hardly helps us to understand.

The recept or generic image is the first of the psychological stepping-stones leading across the unfordable Rubicon, and it is also the principal stepping-stone. Should this prove to be unstable, the transit would certainly become exceedingly doubtful.

From the recept we pass to the concept, which, according to our author, is in its simplest form a named recept. The addition of the name or sign is thus the differentiating character of the concept. We may have generic images, but no concepts apart from names or other signs.

In order to understand how the concept is marked off from

the recept, we must accordingly inquire into the psychological conditions and concomitants of the naming process. And this our author does at some length. He gives us a full and detailed account of names and of signs in general, distinguishing different grades of sign-making from the merely indicative pointing or other gesture up to the bestowal of a general symbol with a consciousness of its significance as connoting certain common qualities. Into much of this it is not needful for us to follow Dr. Romanes, but brief reference may be made to one or two points of special importance as bearing on the evolution of the higher conceptual thought. One of the most curious features of Dr. Romanes's theory of concepts and naming is the proposition that the name is bestowed on the idea, and has for its psychological condition an act of introspection. He tells us that before we can bestow a name on a recept we must be able to set this recept before our mind as an object of our own thought. Or, to express the truth in the author's own words, self-consciousness is the necessary presupposition of naming and so of conceptual thought. Before I can name an idea I must reflect on the idea as mine, and before I can judge in the logical sense, I must realize the truth of the proposition as such, that is presumably as truth for me, so that self-consciousness would seem to come in necessarily at all stages of conceptual thought.

This doctrine seems by no means as clear and convincing as the author supposes. He is, as he clearly tells us, confining himself to the psychological treatment of his subject. This being so, it may fairly be urged that in making an act of subjective introspection an essential factor in the process of naming he is psychologically wrong. Is a child when inventing a name for his toy-horse or doll reflecting on his idea as his and naming this idea? Is he not rather thinking wholly about the object, and is not the name given to this external object and not to the idea in the namer's mind at all?* No doubt the completed process of logical reflection on names and propositions brings in the subjective element—that is to say the mind's consciousness of its ideas and judgments as representations of the realities thought about. But this reference to self, this act of introspection, so far from being involved in every act of conceptual thought, is directly excluded from it.

This brings one to the next point. In naming things the mind is busily occupied, not with itself and its ideas, but with the "not-self," the qualities and relations of the things perceived or rep-

* I believe that observers of children will indorse the remark that children regard names as objective realities mysteriously bound up with the things, and in a manner necessary to them. A nameless object is, for a child, something incomplete—almost uncanny.

resented. And this suggests first of all that naming, properly so called, only begins when things come to be apprehended as such, that is to say, as wholes or unities. And here the question occurs whether an animal, say a dog, that is just coming on to understand a name or two, as that of the baby of the house, can be said to have an organized percept precisely analogous to our own percepts? Dr. Romanes does not raise the question, but, in view of the light thrown by modern psychology on the complexity of the process of perception, it might not have been redundant. But waiving this point as possibly smacking of the frivolous, we have to ask whether an animal at the stage of mental development at which it appears to begin to understand names, and even to make use of them, is capable of carrying out the processes that go along with, and in fact constitute, naming in its true and complete sense. These processes have already been referred to in connection with the subject of general ideas. To name an object appears to mean to apprehend that object as a complex of qualities, to make mental separation of these, and so to relate it to other objects both by way of similarity (classification) and dissimilarity (individuation). To use a name intelligently at all would seem to imply that these processes have been carried out in a rough fashion at least. This being so, we must be prepared when we endow an animal with the power of naming, whether under the form of understanding or that of using names, to say that it is carrying out in a rudimentary way at least these thought-processes. How, it may be asked, does Dr. Romanes deal with this point?

The answer to this question will be found by turning to new distinctions or "stepping-stones" in the movement of thought-evolution. Our author attaches importance to the distinction between higher and lower forms of the concept. Not only is there the generic image to carry us on smoothly from image to concept, but within the limits of the concept itself there are higher and lower forms. Since, according to our author, a concept is any named idea, a proper understanding of these conceptual grades can only be obtained by a glance at his scheme of names.

There are, according to Dr. Romanes, four stadia in the evolution of the complete logical sign or general name. Of these the first is (*a*) the *indicative* sign—that is, a significant tone or gesture intentionally expressive of a mental state, as the characteristic tones by which animals express their emotions. These are not names at all. Next to these in the order of evolution come (*b*) *denotative* signs. These, whether used by children or animals, e. g., talking birds, simply mark "particular objects, qualities, and actions." They are learned by association, and are not consciously employed as names. By the use of such a sign the talking bird merely fixes a vocal mark to a particular object, quality,

or action; it does not extend the sign to any other similar objects, qualities, or actions of the same class; and therefore by its use of that sign does not really *connote* anything of the particular object, quality, or action which it *denotes*. Next in order (*c*) follow *connotative* signs which involve the "classificatory attribution of qualities to objects." This attribution of qualities may be effected either by a receptual or a properly conceptual mode of ideation. For example, a parrot had come to use a barking sound when a particular dog appeared on the scene. This sign was afterward extended to other dogs, showing that there was a certain recognition of the common qualities or attributes of the dog. Similarly when the writer's own child, among its first words, used the term star for all brightly shining objects. Here again there was perception of likeness, but no setting the term before its mind as an object of thought. Lastly (*d*), we have the *denominative* sign which means a connotative sign consciously bestowed as such with a full conceptual appreciation of its office and purpose as a name.

In this scheme Dr. Romanes evidently recognizes the point we are now dealing with, viz., the implication of a true thought-process in the proper use of a name. He seems to be trying to dispense with this as long as possible, with the view of securing a number of intermediate stepping-stones. Can he be said to have succeeded? Does this hierarchy of signs with its parallel scale of ideation carry us up to logical thought? Is it even intelligible? Let us briefly examine it.

To begin with, it staggers one not a little to find that long before the "classificatory attribution of qualities" is possible, the animal somehow manages to mark "particular qualities," whatever these may mean. How, one asks, can a sign be appended to a quality without becoming a "connotative sign"—that is, attributing a quality to a thing? But let us pass to the really important point, viz., the alleged power of the animal, e. g., the talking bird, to extend a sign to different members of a class, and so to attribute common qualities or resemblances to these, while it is unable to form a concept in the full sense. This extension, we are told, takes place in the case of the sign-using bird by receptual ideation. And here the critic may as well confess himself fairly beaten. On the one hand, Dr. Romanes tells us that such a named recept is a concept (lower concept), and, moreover, that the sign employed is a connotative sign; on the other hand, he hastens to assure us that it is not a name, and therefore presumably not a concept, in the rigorous or perfect sense, since the sign is not consciously employed as a sign. Here we seem to have a stepping-stone which it is impossible to define, a sort of *tertium quid* between the image and the concept which is at once neither and

both. Surely if a sound is used for the purpose of marking resemblances and attributing qualities, it is a genuine name, and the mental process underlying it is a germ of true conceptual thought. To say that the parrot attributes qualities, and attributes them in a "classificatory" way too, seems indeed to mean that the bird has got a considerable way along the conceptual path, and is fairly within sight of our distinctions of thing and quality, individual and class. Why logical reflection on this name as such should be needed to raise such a performance to the dignity of a true conceptual act, one is at a loss to understand. And, indeed, the author himself appears to recognize all this in a dim way at least, when he adds that the connotative sign may be the accompaniment *not only* of receptual but of truly conceptual ideation. At the same time this addition may very well complete the reader's perplexity, for it appears to render the next stage of evolution, the denominative sign, unnecessary.

Altogether the author's account of sign-accompanied ideation is not quite satisfactory. To begin with, one misses an adequate psychological treatment of signs in general, their nature and function in our mental processes, such as M. Taine has given us in the beginning of his work On Intelligence. Then our author has left us very much in the dark as to what it is that the sign does for the intellective process, when it begins to be used. On the one hand, since we are told that the mere addition of a name transforms the generic image into a "concept," we naturally expect the function of the sign to be a large and important one. On the other hand, we gather that signs can be used at the level of receptual ideation, where, consequently, true conceptual thought is wholly excluded.

This confusion seems to have its main source in the curious theory that while an idea may be general, it can not become a true concept till it is introspectively regarded as our idea; and its counterpart, that while a sign may be a true sign and even subserve the attribution of qualities to objects, it can not grow into the full stature of a name till it is reflected on as a name. By this doctrine Dr. Romanes seems unwittingly to have substituted the logical for the psychological definition of the concept, and so to have put the latter higher up in the evolutional scale than it ought to be. To this it must be added that the author appears to have been overanxious, with the view of making the transit smooth, to multiply distinctions. Such intermediate forms as Dr. Romanes here attempts to interpolate in the process of intellectual development can not in truth do away with the broad distinctions which psychologists are in the habit of drawing. Thus the recept only appears to connect the image and the concept just because it tries to be both at the same time. So the lower stadium

of the sign only gives an appearance of bridging over the interval between signless ideation and sign-aided thought, just because it aims at once at being something less than a true sign, and this true sign itself.

If our criticisms are just, Dr. Romanes can not be said to have succeeded in his main object, viz., the obliteration of all qualitative difference between human and animal intellection by the interposition of psychological links which can be seen to have the essential characters of both. And here one is naturally led to ask whether the author is after all on the right track. For he is a master of his facts and shows considerable power in the marshaling of his arguments, and, as even a hasty perusal of the volume can show anybody, he has here concentrated his force in a severe and sustained effort. Where he has failed it is conjecturable that others may fail also. And so it behooves us to see whether he has approached the problem in the right way, or, at least, in the only possible way.

The introduction of all this technical mechanism of receptual ideation, lower concepts, and the rest, has for its avowed object the avoidance of all introduction of qualitative change in the process of intellectual evolution. Dr. Romanes tells us plainly at the outset that he is going to establish identity of kind between the animal and the human type of intellection. And, no doubt, if it were possible to do this in the way here attempted—that is to say, by interposing transitional forms which virtually efface all qualitative unlikeness—it would be a great advantage to the evolutionist. But it may be said that it is not the only way of satisfying the requirements of the evolution hypothesis. Dr. Romanes pertinently remarks, in meeting *a priori* objections to the derivation of human from animal intellection, that in the life of the human individual we actually have a series of transitions from animal to human psychosis. Now, a glance at the intellectual development of the individual shows us that distinct qualitative differences are introduced. Not to speak of the obvious fact that every new sensation effects a qualitative addition to the infant's mental life, there is the more important fact that the first image of the absent mother or nurse introduces a new sphere of mental activity. The child that dreams and imagines is already a different being from the infant that merely touches and sees. Similarly it may be said that the first conscious process of breaking up its sense-presentations, the first distinct apprehension of relations, is epoch-making just because it marks the oncoming of a new mode of mental activity, a qualitative extension of its conscious life.

To say this, however, is not to say that the process of development is wanting in continuity. For, first of all, these higher forms of activity introduce themselves in the most gradual way,

and only slowly disentangle themselves from the lower forms which constitute their matrix. Thus the image little by little lifts itself butterfly-like out of its chrysalis, the percept. Similarly, what we call thinking, with its conscious comparing and relating of the products of sense-perception, emerges in the most gradual way out of lower forms of psychosis.

But this is not all, or the main thing. While the higher and lower forms of intellection undoubtedly exhibit qualitative differences, it may be possible to transcend these differences by going deeper, and detecting the veritable elements of the intellective process. This deeper analysis is emphatically the work of modern psychology, and, as every reader of Mr. Herbert Spencer knows, is of vast assistance to the evolutionist in following the psychical process from its rudest conceivable form in the lower grades of animal life up to the highest achievements of human thought. The luminous idea that all intelligence is at bottom a combination of two elementary processes, differentiation and integration, seems to lift one at once high above the perplexities with which our author so laboriously deals. It enables us to say that animal intelligence, just because it is intelligence, must be identical in substance with our own. The qualitative differences between perception and conception, or, to take Dr. Romanes's example, "the logic of recepts" and the logic of concepts, which obstinately persist so long as we look at the process *ab extra*, now appear as mere results of different degrees of complexity, of unlike modes of combination of the ultimate elements; just as to the physiologist the manifold variety of color resolves itself into different modes of combination of two or three elementary sentient processes.

When once this fundamental identity of all intellective processes is clearly apprehended, the question where exactly in the evolutionist's tree the twig of thought proper, or better, perhaps, of conscious generalization, branches off, sinks to its proper place as a question of quite secondary importance. At the same time we may agree with Dr. Romanes that the point has its real historical or genealogical interest, and that he has not done amiss to devote a volume to its discussion.

The question turns mainly on the point how much the animal can do by means of pure imagining and the aid of association. Our author clearly recognizes that this will carry animals some way, and may give to their mental operations the appearance of a true generalizing process. But he has not fixed the limits of this pictorial or suggestive inference with the precision one looks for, partly, no doubt, because his whole view of the generic image as somehow involving a generalizing process tended to obscure from him the real point. One might safely, perhaps, hazard the assertion that the diving-bird can get on very well without any-

thing like a general idea of water, a pure (generic) image being all that seems necessary. On the other hand, one is disposed, on the evidence of the facts adduced by our author, to put the beginnings of the true generalizing process pretty low down. It certainly seems to be involved in the mental life of the ants, as elicited by Sir John Lubbock's experiments, and described by Dr. Romanes (p. 94 and following). And since these particular actions plainly imply the use of signs, and apparently signs capable of indicating such abstract ideas as those of quantity, there seems no reason why we should hesitate to call ants thinkers in the sense of being able to form general notions. The same applies to the mechanical inventions of the spider, described by Mr. Larkin (p. 62). Similarly, it is difficult to deny the rudiment of "conceptual thought" to a fox who can reason on the matter of traps in the way described by Leroy (p. 56), or to a dog that was cured of his dread of imagined thunder by being shown the true *cause* of the disturbing noise, viz., the shooting bags of apples on to a floor (pp. 59, 60). No doubt there is a danger in straightway endowing animals with mental qualities identical with our own, when their actions resemble ours. There may, of course, be two psychological explanations of the same action. We can not, however, escape our limitations, and, if we are to deal with animal ways at all, we are bound to interpret them in terms of our own mental processes.

The hesitation of the evolutionist to attribute rudimentary thought to animals, in which Dr. Romanes evidently shares, is no doubt due to the firmly established assumption that we generalize by help of language. To the nominalist more especially it savors of rank heresy to hint that animals apparently destitute of signs may be capable of generalizing their perceptions and reaching a dim consciousness of the distinction between the universal and the particular.

But is the nominalist's assumption that language is the indispensable instrument of thought above challenge? A considerable part of Dr. Romanes's volume deals with the relations of thought to language. He gives us a fairly good summary of the results of research into the origin of language. It can not be said that these throw much light on the question. Perhaps it is unreasonable to expect that they should. Our author contends with some skill as against Prof. Max Müller that the earliest traces of human language suggest a highly pictorial and non-conceptual mode of ideation. And in his ingenious hypothetical account of the genealogy of man as the articulate reasoner our author inclines to the idea that, so far from language making the thinker, the endowment of language has to be ingrafted on a high quality of intelligence, and even then to undergo considerable development before it becomes a mechanism for conceptual thought.

The whole subject is still a dark and perplexing one, and we must refrain from dogmatizing. It may, however, be contended that the evidence on the whole supports the view that the generalizing process is up to a certain and not very high point independent of language. That is to say, an animal unassisted by any system of general signs may make a start along the path of comparing its observations, resolving them into their constituents, and separating out some of these as common qualities. Whether in these nascent operations of thought there is some substitute for our mechanism of signs, we do not know and perhaps never shall know. However this be, they remain nascent processes never rising above a certain level. The addition of some kind of sign which can be used as a mark of common features or qualities seems to be indispensable to any high degree of generalization, and to any elaborate process of reasoning. It is the want of such signs, and not the lack of the "power of abstraction," that keeps certain animals, for example the dog, from being rational animals in as complete a sense as a large number of our own species.—*Nineteenth Century.*

AN EXPERIMENT IN EDUCATION.

By MARY ALLING ABER.

SECOND PAPER.

ENGLEWOOD, Ill., is now a portion of the city of Chicago; but formerly it was a suburban town with an independent school system. In October, 1886, Miss Frances MacChesney, a primary teacher in the Lewis School, obtained permission from her principal, Miss Katherine Starr Kellogg, and her superintendent, Mr. Orville T. Bright, to try some work on the lines wrought out in the experiment made at Boston.* Her request was granted, on condition that she would complete the grade work in the required time.

At first nothing was attempted beyond the giving of simple science lessons as bases for reading lessons. In these the children were furnished with specimens, and led through their own observations to the acquisition of facts and ideas, which the children expressed; these expressions put upon the blackboards constituted the reading matter, and were written in script or print on slips of paper for further use. At this time Miss MacChesney herself thought of the work mainly as a more interesting way of teaching reading; and, although the basal lessons were usually drawn from Nature, little attention was paid to the quality and value of the

* See this Monthly for January.

ideas thus used. Later, the fundamental idea of the Boston experiment was taken up, and the chief attention directed to the selection of topics and materials for real science lessons.

In this work no effort was made to introduce the vocabulary of the reader assigned to the grade. In February that reader—Appletons' First—was given to the children for the first time. To quote Miss MacChesney's own words: "The interest which had been awakened by the reading of their own thoughts was transferred to the books, and the grade work was completed before the required time—thus more than fulfilling the condition on which the trial was allowed to be made."

The work in reading went on in this manner during a second year, all other grade work being done in the old ways. During the third year systematic lessons on minerals and plants were given, and work in literature begun; and the children's sentences were written out on a typewriter. In a letter written at the close of this year, Miss MacChesney says: "Out of a room of forty children, divided equally into two classes, one class finished the first year's work in eight months; the other class, with the exception of two children, completed the grade work at the end of the year, besides doing all the extra work; and the whole was accomplished with ease and happiness on the part of both pupils and teacher." During the first year of trial, another teacher in the Lewis School, Miss Quackenbush, became interested in Miss MacChesney's work, and began a similar attempt with her own class. In a short time she produced excellent results.

From the first, Mr. Bright carefully watched the progress of the trial, and willingly and patiently waited its results. When convinced of the superiority of the principles involved and of the results obtained, he earnestly championed the cause, and has continued to be its enthusiastic supporter.

During the second year, teachers' meetings were called, discussions aroused, illustrative lessons given, courses of lectures for the teachers projected, and other teachers joined in the work. A teacher wrote me at the time: "I never saw teachers so ready and eager to 'speak in meeting'; . . . I never saw them so thoroughly awake." Finally the principals and teachers of the Englewood schools generally waked up to the fact that something new and interesting was going on in their midst; the idea spread, and many visitors came from adjoining towns.*

* In the fall of 1888 Miss MacChesney gave a series of lessons on grasshoppers and beetles. These the children caught for themselves, but she herself killed and preserved them in alcohol. The following summer, while teaching at an institute, she was attacked quite fiercely for this part of her work, on the plea that it was inculcating cruelty. I should like to ask all who bring this plea whether they eschew roast beef for dinner. Shall a million beasts of a high grade of intelligence and finely wrought nervous systems daily wit-

At the beginning of the fourth year a printing-press was provided; but each teacher furnished her own type, set it, and did the printing for her class. During this year, after four months of the new work, one division of Miss MacChesney's class "completed the grade work in reading in three months, a thing never before done at Englewood." Concerning this year Miss MacChesney says further; "From the experience which this year has brought me, I am thoroughly convinced that, could the average child have from the first the results of his own observations put in printed form, and enough of phonics to enable him to find out new words, the reader could be withheld until the latter part of the year, when it would be read with relish, and as a book ought to be read. . . . The power gained by the children to observe closely, to tell clearly and concisely what they have observed, and the power of logical, connected thinking is not confined to their science and reading, but is felt in all the work of the schoolroom. . . . In looking back over the time since we began working out this theory, I see a constant increase in the power of the classes that have been led along this path."

In regard to the influence of this work upon herself, Miss MacChesney, during the third year, wrote me, "At night I can hardly wait the morning, so eager am I to begin another day, and see how the children will go through the work planned for that day." Here she reaches the true work of the teacher—to watch and direct the growth of the children's minds. From letters received from Miss MacChesney during 1889–'90 I cull the following: "I started out to try what seemed a theory of doubtful utility to public-school children, and found all my work and my life enlarged and beautified. . . . I am certainly happier than I have ever before been in teaching, and I know I am doing more for the children intrusted to my care. . . . Mr. Bright, in order to speak with assurance about these matters, visited fifteen city teachers; and in no case did he find the attention of teachers or children directed to anything but the symbol, and in no case were the children further advanced than ours where thought and symbol go hand in hand. . . . I did not meet with any opposition in the work. The only requirement that I must meet was 'the grade work

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ness the scenes in ten thousand slaughter-houses, and themselves be the victims of the loathsome indifference to cruelty there practiced—shall this exist and pass uncondemned, because its results are pleasant to the appetite of the body, and the cry of cruelty be raised when a few hundred grasshoppers are killed for purposes of study? Is the body of more value than the mind, and nourishment more desirable than knowledge? So long as slaughter-houses exist, so long will it seem desirable to teach children reverence for animal life by minute personal study of the wonder and beauty of organ and function in the lower forms. When slaughter-houses have been done away with forever, the human mind will find a better way to teach zoölogy. Let the cry of cruelty go forth, but not from those whose own flesh is built up from the flesh of their brute brethren.

accomplished in the required time'; and whether I could do that was asked over and over again. . . . The greatest trouble" (referring to the days before they had a printing-press) "was the lack of printed matter. I met no criticism from parents and much praise. Especially was this true of the work in literature. . . . The criticism oftenest given by visiting teachers is on the 'big words,' as they call them." Elsewhere, in regard to these "big words," she says: "They" (the children) "were proud of their new possessions, and lost no opportunity to use them and use them correctly. The so-called 'big words,' when they express a definite idea, are remembered with ease, while their humbler sisters which express nothing tangible are more readily forgotten. . . . We can say emphatically that the work can be done in the public schools, and that both teachers and pupils are benefited thereby."

Another Englewood teacher wrote me: "The teacher gains an impetus in searching for and assimilating real truth to give to the waiting little ones. . . . I believe the parents of our children are becoming awakened, for children tell me of searches made at home to answer whys and hows, whens and wheres, that have been raised in the work at school."

Miss Walter, critic teacher at the Oswego (New York) State Normal School, after a visit to Englewood in February, 1890, wrote me: "It has been my good fortune to see within the last week some of the best school work I have ever seen. . . . It was in the rooms of Miss MacChesney, Miss Quackenbush, and others that I saw such admirable work. . . . Miss MacChesney is carrying out, in a wise and careful manner, an ideal line of work."

In closing this account of the new work at Englewood I can not do better than to give quotations from two letters received from Mr. Orville T. Bright, the superintendent under whom all this experimental work has been done. He says:

December 15, 1889.—"We are now harder than ever at work studying how to make observation a living element in our schools. . . . We have thirty—yes, forty teachers now who are thoroughly in earnest in the matter."

March 9, 1890.—"It is about three years since Miss MacChesney began the work. Miss Quackenbush soon followed, and the next year Miss Phelps, all in the Lewis School; . . . and the fact was demonstrated beyond a doubt that fifty children are no bar to the success of a teacher in training little children to observe in subjects pertaining to science.

"All our primary teachers slowly wheeled into line. We had numerous meetings and discussions on the subject, and every one who tried the work was convinced. The stand of the superintendent had been misunderstood from the first, but he did not think it wise to force matters. He wished teachers to undertake

the work because they believed in it; and now every first and second grade teacher in the district—thirty-five in number—are in hearty sympathy, as are almost all of the third and fourth grade teachers, about sixty in all. Not all, however, are at work.

"There has been no systematic arrangement of material, only so far as individual teachers have made it in a small way. Our aim has been to demonstrate the feasibility of doing the work with large classes, and to prove the growth of children under the training possible. These two things we have done; and we are now at work upon a related plan for the several grades. The scheme must be a flexible one, and it can be so arranged; but the second grade work must grow out of and be an advance upon the first, and so on. We have discussed *motive* first for several weeks. Now we are on material; then will come method. These I can not write about now. We hope to see the subject in some kind of shape before the end of the school year."

Do not the results of the trials at Boston and Englewood virtually constitute a plea to parents and teachers to investigate this matter—not necessarily to follow, but possibly to get suggestions about a better way; for the contemplation of a new thing sincerely conceived sometimes leads to the inspiration of a better?

Pupils in all sorts of schools seem, for the most part, unable to distinguish between opinion and fact; their reasoning processes are easily overturned, imperfect, slovenly; their power to discriminate values is slight; and the whole working of their minds lacks cohesion, totality, and gradation. Is not the human mind naturally capable of trustworthy action, and is not the lack of such action in the average adult due to faulty education? To see clearly, judge fairly, and will strongly—are not these the great ends of education? Should not a man have as great a consciousness of mind and of power to think as he has of hands and feet and power to use them; and should he not be as unerring in the right use of the one as of the others? Should not the schools give this consciousness and power and mental skill; and also fill the mind with ideas worth the effort of getting and retaining?

The maxim, "Ideas before words," adopted by teachers like Prof. Louis Agassiz, has produced great results in changing the methods of study in the natural and physical sciences. This influence has extended to other departments in the older centers of learning, but the majority of our higher schools are yet scarcely touched by it. In these, study results in little more than filling the mind with words; and from them students pass into life without the taste or ability to examine and estimate facts, and to form independent judgments and volitions.

In primary education the maxim "Ideas before words" is re-

peated with tiresome iteration, but seldom is a question raised about the value of the ideas taught. Do the charts and books for primaries express aught that is unfamiliar to children? Rather do they not contend for the merit of expressing most completely the commonplaces of child-life? Is there anything worthy to be called thinking or capable of arousing interest and emotion in memorizing combinations of symbols, and associating them with familiar and trivial ideas? And let us see what "object-lessons" chiefly deal with. Last year, in a normal school of the Empire State, a teacher of primary methods, proudly claimed by her principal to be the best in the State, gave thimbles, scissors, chairs, etc., as suitable subjects for object-lessons, and carefully led her pupils through the steps required to develop in children's minds ideas of the parts and the uses of these objects. Is there one child in five hundred, at six years of age, ignorant of these parts and uses? Then the so-called development process is a farce, and a waste of time and energy. Look over manuals of object-lessons and courses of study for primary children: you will usually find but few subjects leading the child from the beaten path of his daily life into new, inviting, and fruitful fields; and of these, note the directions as to what is to be taught. Such directions often resemble a lesson on a butterfly that I heard given by a kindergartner. With a single butterfly held in her hand she led the children to speak of its flying in the sunshine, sipping food from flowers, living through the summer, and of the beauty of its colors. Not a word was said of the three parts of the body, the two pairs of wings, the six legs, the antennæ, and the tube through which it sips food—all of which and more the children could easily have been led to see. Doubtless the teacher thought the children had had a beautiful lesson; but had they received anything at all? Although city children, they spent the summer in the country—they had all seen and probably chased several species of butterflies, and possibly some of them knew more than their teacher about the habits of butterflies.

Think of children gathered by fifties in thousands of schoolrooms, spending the first years of school-life in repeating *trivial facts and ideas that have been familiar from babyhood;* in learning the symbols for these ideas, and in counting beans and bits of chalk! The five-year-old boy who described a kindergarten as "the place where they are always pretending to do something and never doing it," and the eight-year-old girl who, after reading the first few paragraphs of some ordinary primary reading matter, looked up at her teacher and said, "I think these sentences are very silly, don't you?" are not alone in preferring the lessons of the street and the field to those of the school-room. In such dealing with trite ideas the child gets little mental exercise, gets

no addition to his knowledge save the written and printed symbols, gets no increase to his vocabulary, and little facility in using it. For these slight gains he gives the freshest, best years of life, and exhausts in weariness of spirit the fountains of intellectual interest and enthusiasm.

In the experiment an effort was made to bring the child at once into contact with the real substance of education. It is this concentration of attention upon the subject-matter, not upon the method of teaching it; on the kind of ideas, not upon the symbols of ideas, that chiefly differentiates this experiment from ordinary primary work, and makes the use of the word experiment legitimate. The value of method is heartily conceded, but what shall be taught was thought to be of more importance. Is it not a law of Nature that new and valuable ideas only can arouse interest and lead to worthy thoughts? When such thoughts exercise the mind, do they not exclude the transient and trivial, lead to culture and right conduct, and so further the true end of existence—the perfectionment of the soul?

Do not the showy, the superficial, the transient, the seeming, rule the hour? Where do we find the heroic dignity that should inhere in man and woman? Few pursue truth and righteousness for their own sakes regardless of consequences; in few does the love of humanity overcome the shrinking from poverty and calumny. Are we becoming a nation of cowards and infidels, that we can fear nothing but material and intellectual discomforts in this one short life?

To awaken love for great literature, to arouse interest in local history, to develop a habit of observing Nature's phenomena—to do these before the mind has sunk itself in materialism and the love of sensual delights—to do these while the child is still so young that mind and heart are plastic and responsive, is indelibly to impress the idea that these are the legitimate objects of study whose pursuit leads, not to learning only, but to nobility of mind, and to real, satisfying pleasures. One can not know and love the great in the world's literature and not be ashamed of mean thoughts; one can not be a student of history without bringing to bear upon the affairs of our own time a greater intelligence than the majority of our politicians exhibit; one can not habitually observe Nature's phenomena without extending that habit to the highest and most interesting of her creatures—man; and one can not observe man, with any depth of insight, without being profoundly impressed, not alone by the miseries of the very poor and the never-ending drudgery of the laboring classes, but by the lack of unselfish zeal, heroism, dignity, truth, gentleness, generosity, and purity among the well-to-do; one can hardly view the course of Nature and history from remote ages to the present

without seeing through all a tendency to completion, order, and beauty on an ever-rising plane, like the threads of a spiral; and, seeing this, to desire to be himself in harmony with that tendency and a factor in aiding it in his own time.

I put forth no claim to the Boston experiment or the Englewood trial as a cure for existing evils; but I urge every educator who loves mankind to investigate each new departure in education, to test any that seems to have good in it, to cease to concentrate attention on symbols and shows, and to turn thought to such realities as can nourish the mind and heart, and be retained as valuable furnishings for all the years to come, and to do these from the first day in the primary school.

[*Concluded.*]

HOMELY GYMNASTICS.

By ALICE B. TWEEDY.

WHILE voyaging over many seas of experiment in search of education, some of us are beginning to apprehend that the golden fleece of mental culture will not create for us the symmetrical man or woman. As a consequence, various systems of bodily training are receiving close attention from teachers and reformers, while athletic sports are now honored and encouraged in schools and colleges where not many years ago they were merely tolerated as safety-valves for unsubdued vitality. We are returning to Greek ideals, but the elimination of the mediæval and Puritanic expression of contempt for the body is a slow process, and the formula still meets us variously masked in life and literature. Now, it is the notion of the spiritualizing effect of invalidism, or delicacy of health; their debasing tendencies toward selfishness and morbidity being ignored. Again, it is the exaltation of nerve sensitiveness into an evidence of refinement; forgetting that the healthy nerve, like the pure metal, stands the normal test put upon it, the flinching being a token of failure as the alloy is of gold. In another instance, it is the scorn for manual labor, although this indicates also the survival of feudal feeling. We call the hand the servant of the mind, thinking we have ranked it, but educating the blind shows us that it may turn instructor and incite its ignorant master to action.

This is an age of fads and fetiches, and, as we give up our idol of disembodied intellect, we erect a shrine to meaningless muscle. We have outgrown croquet and archery. Even tennis no longer suffices, and we are founding schools of physical culture and gymnasiums *ad libitum*. In truth, these are needed badly enough

by the physically idle, and if strength of body is our aim, a beginning must be made somewhere in its training. Does it not savor, however, of absurdity that the girls, who not long since were frowned upon for being "tom-boys"—i. e., using their muscles in running and jumping—and afterward were cautioned against running up and down stairs or taking long walks, should be suddenly precipitated upon parallel bars and turning poles, where there is emulation and a slight danger of overdoing? Very far am I from believing in any inherent physical frailty of women, or that it is not good for a girl to turn a somersault or learn hand over hand. It is the inconsistency of such philosophy that calls for comment.

Unquestionably the best exercise is that taken in the open air; and rowing, running, walking, skating, horseback-riding, have forever the advantage over indoor training, in that they oxidize the blood as well as develop muscle. Gymnastics, on the other hand, has two special claims—economy of time and defiance of weather. But it is not only to the gymnasiums, equipped with apparatus and superintended by doctor or professor, that we need betake ourselves if muscular development is our object. These are attractive, and have advocates enough. Within our doors there is a despised sort of gymnastics which has few scholars, fewer teachers, and stands in great need of intelligent attention. The evangel of cookery has been preached to us from all quarters, but what missionary has been bold enough to proclaim the use and dignity of house-work?

"Nothing menial for me!" cries the ignorant woman; while her more intellectual sister exclaims, "Oh, I feel above such drudgery!" Alas! to what giddy heights must those minds be elevated which do not see the necessity nor compensation of muscular work! Mr. Gladstone can find refreshment for his brain in chopping trees, and an eminent jurist of the United States in vigorously plying the saw; but there are women so highly refined that they can no longer employ their muscles for any useful purpose.

In the pretty allegory of Homely and Comely, Moncure D. Conway contrasts for us two common mistakes, neglect of housework and exclusive devotion to it, but shows also a health and beauty balance on the side of Homely.

That there is not much sanitary or strengthening influence in the operation of dusting is evident; and yet many women, disdaining heavier work, reserve this domestic duty for themselves and waste much time upon it. Muscular motion is of little value unless vigorous and swift. The slow walk and loitering movement do not rouse the blood from its torpidity. The lowliest labor when zealously performed may be followed by an unex-

pected hygienic effect. There is the instance of a penniless young man, threatened with fever in a strange country, shipping as a deck-hand to return and die among his people. During the voyage he scrubbed away the dirt from the ship-boards, and with it the disease that had invaded his life-craft. A story is also told of a family whose women were of the delicate, ailing sort. Misfortune obliged them to perform their own domestic work. What seemed for them a sad necessity proved itself a double blessing. They gained what they had never known before, robust health; and their enforced economy restored them to a prosperous condition.

Not all physicians are clear-sighted or independent enough to prescribe as did one of their number. A young lady supposed to be suffering with anæmia, nervous prostration, and other fashionable ills sent for the family doctor. "Is there anything I can do to get well?" she asked, after the usual questioning. "There is," answered he; "follow this prescription faithfully." The folded scrap of paper read as follows:

"One broom: use in two hours of house-work daily."

That domestic work is not without its æsthetic side many authors bear witness. George Eliot introduces us to Hetty Sorrel at the butter-making, and writes, "They are the prettiest attitudes and movements into which a pretty girl is thrown." But if dairy-work is rapidly taking a place beside spinning and weaving as one of the picturesque employments of the past, what there is to do about the house may be also gracefully done. And here, it may be said of this as of all other work, the spirit and care we put into it endow it with beauty as well as health.

Aside from the physical view of homely gymnastics, there is a social and an economic aspect. Courtship need not wait upon a problematic income if the fair Dorothea has not only a clear head but arms willing to take up the burden of life equally. Does Hermann need to toil? She deems it incumbent upon her, unless busy with young children, to earn her own living within the home or outside of it. When women shall have been educated to a keener sense of justice, they will no longer imagine they have discharged their debt to the community by adding a few beautifying touches to the household furniture! Nor, although they fulfill the higher and more exacting duties of a mother, will they thenceforth fold their hands and do nothing. To be a good father does not absolve a man from work, neither does being a good mother exempt a woman from her share in the maintenance of the home. The maiden of to-day is yet enslaved by caste culture; but the maiden of to-morrow may scorn to be merely ornamental or useless. She may be too proud to allow her husband to support her in idleness and may refuse to be re-enforced by a

Biddy or Gretchen unless there is more to do than one pair of hands can accomplish.

The practice of these domestic exercises has also an important influence upon household service. The mistress who understands all the work required by her, and performs part of it herself, rarely has any trouble with servants. But, in order to attain this result, she must know more than the manner in which any piece of work is to be done; she must know how long it takes to do it, and in order to estimate this justly she will need to make practical trial of it herself without assistance. The knowledge and skill she gains in this way will also enable her often to suggest an easier method or better arrangement of work. The ridiculous requirements made in some households where there is a lack of service, and which result in frequent changes, would not be possible if the mistress had learned this lesson in its entirety.

Can it be repeated too often that it is the sign of ignorance to scorn any work well done, or the doer of it? Only when the dignity and importance of labor are rightly estimated can we hope for any well-founded social prosperity. While it is not suggested that wealthy women should discharge their servants and undertake their own domestic work, it may be urged that only good can come from their personal performance of some share of it—physical benefit to themselves and a more wholesome feeling for the labor of their necessitous sisters. Between the small minority who suffer from too easy living and those whose days are overburdened with care, there exists, especially in cities, a large class of women in moderate circumstances whose health would be greatly benefited by more physical exercise. These need not rashly bestride the bicycle, nor rush through the non-productive drill of the gymnasium as an only means of grace. They may garner their resources, develop their muscles in walking and in reconquering a world of flexibility and strength which lies within their own thresholds.

NEW evidence of the existence of a vibration or some other motion of change in latitude was presented to the American Association by Prof. C. L. Doolittle, who describes the results of between eleven and twelve thousand observations, made during the last fourteen years, at the Sayre Observatory, Bethlehem, Pa., showing that such variations were recorded. Prof. George C. Comstock, of Washington Observatory, Madison, Wis., deduced from similar observations at Königsberg, Pulkowa, Washington, and Madison, a theory that the north pole is moving along the meridian at the rate of four and five tenths of a second per century. The active discussion that followed the reading of these papers is an indication of the interest that is taken by men of science in a subject that has only recently begun to attract attention.

NEW OBSERVATIONS ON THE LANGUAGE OF ANIMALS.

By M. De LACAZE DUTHIERS,
OF THE INSTITUTE OF FRANCE.

I HAD occasion, in a note published several years ago in the Revue Scientifique, to mention a parroquet which I have since continued to observe, the manifestations of whose intelligence are both interesting and instructive. Many acts of birds are difficult of interpretation. To speak only of their songs, the meanings of most of the innumerable varieties of sounds which they produce, and of their diverse warblings, escape us completely. It is not possible to find the meaning of these things except by forming suppositions and hypotheses, or by catching the connections between cries and acts. But instances of the latter kind are extremely rare in comparison with the great majority of the manifestations made by animals.

Thus, to select examples which every one can observe, when a canary-bird is warbling in its cage and becomes deafening, or when a lark rises straight up in the air and *incantat suum tirile tirile*—sings its *tirile tirile*—as Linnæus picturesquely expresses it; when a tomtit, leaping from branch to branch of a willow or among the reeds, repeats its florid warblings; when a raven croaks; when a blackbird whistles—what significance can we attach to their songs and their cries? Certainty is impossible, and we can only form more or less plausible hypotheses concerning the interpretation of them.

The parrot furnishes us one more aid in this matter than other birds, and this helps us, to a certain extent, in overcoming the difficulty of interpretation. It has an articulate voice, and when we have taught it a few words, the meaning which it gives them may be better divined by us according to the tone and the rapidity or slowness of its utterance. This permits us to discover the feelings that move it, for we can better judge from an articulate sound than from one that is merely musical.

Much has been written on the language of animals. It is neither my desire nor my intention to repeat here all that may have been said on this subject. It would take too long and would be of no use. I have often witnessed facts that may be of interest to those who are occupied with the mental manifestations of animals. I will simply relate them; and of such as are already known, I will merely mention them anew, admitting in advance a priority for others which I do not demand for myself.

There can be no doubt that animals communicate their impres-

sions by an inarticulate voice. Common sense and the most superficial observations are opposed to the negative of this proposition. But when a canary-bird warbles till it stuns us, or a nightingale sings in the shadows on the fine nights of June, can we follow and discover the significance of those modulations—now sharply cadenced, now slowly drawn out, and ending with a trill long and accurate enough to challenge the most skillful musician?

All the poets of every country have constantly sung of the songs of Philomela. But their fervent and enthusiastic verses cast little light on the value of the nightingale's song. It is said that the male sings for the entertainment of the sitting female, but there is no proof of the assertion. The note warning of the approach of danger is easier to recognize. The bird utters a short, hoarse cry, and repeats it with a succession of *trrre, trrre,* which is impossible to mistake. When we hear this cry we may be sure that an enemy is near. Music gives way to a cry of distress and warning, and the female leaves her nest if the sounds become piercing. What do we know of the gobbling of the turkey, which the whistling and the cries of children excite? They are doubtless responses to those challenges; but what do they mean?

The crowing of the cock, recurring regularly at fixed hours, has some signification, but we can not comprehend it. If on a fine afternoon in autumn the cock crows, and repeats his strain between two and four o'clock, the countrymen in some places will say there will be a fog on the morrow, and they are generally not mistaken. Hens do not mistake his notes either; when a leader of the troop, coming upon a spot rich in food, utters his peculiar chuckle, they run from all around to share the find with him. It is evident that the cock has called them and they have understood him. These facts indicate that there is some definite sense in this inarticulate language; and examples of it, taken from other groups, might be multiplied.

The dog, intelligent animal as he is, manifests his affection on meeting his master, with peculiar cries which vary with the intensity of his joy. No one could confound these notes of pleasure with those which he utters when he is angrily driving away a beggar, or when he meets another dog of unpleasant appearance and puts himself in the position of attack.

An interesting study of the voice of the dog on guard may be made in the country at night. If another dog barks in the distance, the house-dog answers in a peculiar manner. He gives a few growls, stops, seems to listen, begins again, very often getting answers; and, after two or three interruptions, he terminates his barking with abrupt yelps, loud at the beginning and long drawn out, and gradually dying away. This ending of his cries is habit-

ually accompanied by his raising his head and throwing it back. I have often, when within the house, on hearing the watch-dog bark in this way, opened the window to assure myself on the subject, and distinguished, as I could not do with the windows closed, the voice of another watch-dog barking in the same way in the distance—the barkings of the two dogs alternating, one answering the other. There is in such cases an evident communication of impressions. One of the dogs, having had his attention aroused by some unusual noise, has transmitted his impression to the other, as sentinels posted at intervals call out their warnings one to another. I have often repeated this observation during the long evenings of winter.

Another example, little known in thickly populated countries, is drawn from a curious scene which I witnessed during a winter passed in Perigord Noir. We had remarked that for several nights the three watch-dogs, a young and an old male and a bitch, howled often toward midnight, but in a peculiar way. One night in particular, during their tedious concert, just as we had got to sleep, they mingled with their cries howlings like those they would have uttered if they had been beaten, with a shading hard to define, but which we perceived plainly; and we remarked that, leaving their kennel in the avenue that led up to the lodge, they had come to close quarters with one another at the gate, with alternating howlings and plaintive cries. Inquiring in the morning for the cause of these singular cries, the peasants told me that a wolf had passed, and predicted that it would return. They said, too, that a neighbor's hunting-bitch had disappeared, and its bones had been found in the fields near a wood. We were awakened again about midnight by the cries of the dogs, and the scene was renewed. Informed as we now were of the nature of what was going on, we ran to one of the windows, whence we could see, in the clear light of the moon, all that passed. The three dogs were cowering against the gate, the oldest one howling by the side of the others, while the younger one and the bitch were exposed at intervals to the attacks of another animal, browner than they, and of about their size, without defending themselves, but moaning as if they were undergoing a vigorous correction.

Frightened, doubtless, by the opening of the blinds of the first story above him, the strange animal had gone away and was sitting in the middle of the road. We could only see that he had straight ears. While we were going down to get a gun the visitor came back to his charge on the dogs, which had begun howling after he left them, and resumed the cries significant of chastisement when they were attacked again. For some reason, perhaps because he heard the click of the gun, the foe drew back and sat down in a garden-walk, concealed by a bunch of shrub-

bery. The three dogs, notwithstanding our reiterated urging, were no more disposed to pursue him than before. If the assailant had been a dog they would have rushed upon him, but they stayed cowering at the gate and howled distressfully. The bitch was most affected, and they all seemed paralyzed by fear. It is said in the country that bitches are especially liable to be attacked by wolves. It was so here. The most certain feature in the matter was the terror of the animals. They were capable of resisting the attack three times over. The young dog was a savage one, and passers-by were afraid of the bitch; but that night they were terrorized, and all incapable of defending themselves. Their cries were therefore due to the same cause as in the preceding night—the presence and attacks of the wolf. I could not have realized their meaning if I had not been a witness of the scene—that is, I could not have correlated the cries and the acts.

A shot at the animal behind the bushes was followed by a hoarse cry. He was hit, and ran; but, in spite of our urgings, the dogs stayed at the gate and only stopped howling. Under any other conditions, upon the signal of the shot they would all have started in pursuit of the wounded animal.

A wolf came to the farm during the last winter (1890–'91) and attacked the same bitch. He would have carried her off, for he had seized her by the throat, if we could judge from the stifled cries she uttered; but this time he found with her a new watch-dog—a mountain bitch from the Pyrenees—of a breed that attacks the wolf and the bear. The wolf would have been caught if he had not run away. He did not return, for he had been attacked, and learned what he had to deal with.

The Pyrenean breed furnishes excellent watch-dogs. I knew one of remarkable traits. At evening he would go round the house, giving two or three growls at each door. With his head raised he seemed to listen to his fine voice, then he would start again and go to another door. He seemed desirous to show those who were observing him that he was attending to his post as guardian. He then went away in silence along the walk, through a dark, rising hedgerow, leaping the slight hillock, yelping, toward the wood. He listened, yelped again, and went in. There was never any failure in this performance, but every evening as night was coming on he began his round, which no one had taught him. It was all done in his function as a guard. It would be hard to determine what his yelps meant, but there were in them an inflection, a sonorousness, and a continuance quite different from those he uttered when pursuing a passer-by or when going to meet a person coming toward the house. Every one who has a watch-dog is able to tell by the sound of his barking when a person is coming up, and usually what sort of a visitor it is.

The peasants' dogs of the southwest of France dislike the country millers, because of the long whips which they are always carrying and snapping, and with which the dogs, running after them, are often struck. From as far off as the snapping of the whip can be heard, the dogs come to wait for the millers and pursue them; and it is easy to recognize when the millers are passing, by the behavior of the dogs. There is in this also a significance, at once aggressive and defensive, in the cries which one can, by giving a little attention, soon learn to distinguish.

Another example of the reality of the various meanings of the cries of the dog under different circumstances is afforded by the companies that collect around a female in heat.

I have a very intelligent and experienced brach-hound, the same which with the bitch had to face the attack of the wolf. He amuses me much at my country lunches. Hunting-dogs which have been much with their masters at lunch do not like to have the drinking-glass offered them. This dog was much afraid of the glass, and I had only to present it to him at lunch-time to make him keep his distance. I used to keep my door open at lunch, for the amusement of observing how I could make him stop exactly at the threshold without stepping over it. If he had passed over it I could always send him back by casting toward him a few drops of water from the bottom of the glass after drinking. Sitting, as was his habit, on the sill of the door, with the tip of his muzzle never extending beyond the plane of the panels, he would follow my motions with the closest attention, reminding me, if I failed to give him a sign of attention, by a discreet, plaintive cry, that he was there. But if I touched my glass he would spring up at once; if I filled it, he would put himself on guard, utter a kind of sigh, sneeze, lick his lips, yawn, and, shaking his ears briskly, make little stifled cries. Then he would grow impatient, and more and more watchful and nervous. When I lifted my glass to my lips he would draw back, working gradually nearer to the farther door, and at last disappear and hide. One who was looking at him without seeing me could tell by his wails and his attitude the level and position of my glass. When the glass was horizontal, I could see only about half of his head, with one eye regarding me fixedly, for that was usually the critical moment—the one, also, when the wails and restraints were most demonstrative of the anxious fear of my poor animal.

When we dine in the kitchen, which is on the ground floor, the dogs are usually all put out. There are four of them, three young and not experienced, and this old, sagacious brach-hound. He insists on coming in, and, to gain his purpose, tries to have the door opened. Although no person may be coming up the walk, he dashes down it barking, all the others going along too

and yelping with him; then he stops, remains a little behind after having got the others out of the way, and, turning his head from moment to moment, looks to see if the door has been opened, for we generally go to it to see who has come. In that case the feigned attack is successful, and the dog, who has evidently meant to give the alarm so as to have the door opened, comes in at once and claims a place at the table. He has accomplished his end, for the door is usually shut without paying attention to his having got in. I have frequently witnessed this stratagem, and when, during my kitchen dinner, I suddenly hear the dogs yelping after the brach-hound has begun, I am pretty sure that nobody is in sight.

I have forgotten where I found the next story of an old dog who was also very sagacious. Hunting-dogs, when they grow old, become rheumatic, or are at least debilitated with pains. We know, too, that they crave heat, and get as near the fire as possible—a craving which increases as they grow older. One such dog, older than the others, and slower in getting into the lodge on returning from the hunt, was often crowded away from the fire by the other livelier dogs getting all the best places before him. Finding himself thus turned out in the cold, he would dash toward the door barking, when the others, supposing it was an alarm, would rush away too, while the old rheumatic went to the fire and selected a place to suit him.

It is not necessary to dwell upon the intelligence shown by such acts. But it is hardly contestable that the old animal, who knows how to play such tricks upon his less experienced companions, deceives them by his intonations, while he is well aware that no enemy is approaching the house; but he does it scientifically, by the inflections of his voice, as a man speaking to other men would do in announcing the arrival of an imaginary enemy.

Inarticulate cries are all pretty much the same to us; their inflections, duration, pitch, abruptness, and prolongation alone can inform us of their purpose. But experience and close attention have shown us the connection of these variations with the acts that accompany or precede them. Animals evidently understand these inflections at once. We can not better compare the language of animals than with what takes place in a pleasant sport, a kind of pantomime of the voice or language which many youth doubtless understand, and which I venture to refer to here to aid in more easily conceiving of the communication of thought among animals by sounds which seem to us all alike. When I was engaged in hospitals, the evenings in the guard-room were sometimes enlivened by the presence of a companion who excelled in humorous mimicry. He would represent a man in liquor who had stopped at a fountain that flowed with a gentle

sound, somewhat like that of his own hiccough. A single oath, pronounced in different tones, was sufficient to enable us to comprehend all the impressions, all the states of mind through which this devotee of Bacchus passed. The oath, at first pronounced slowly and with an accent expressing relief, represented a feeling of satisfaction, with shadings of prolonged exclamation which it would be hard for one to imagine without suggestion. The continued flowing of the fountain made our drunken man impatient, and he wanted it to stop. This state of mind was translated by a new modulation of the same word. In a little while the gurgling of the fountain produced astonishment. Was it possible that he, with all the liquid he had imbibed, could vomit so much and for so long a time? This mental condition was expressed by a new modulation of the same oath. The first movement of surprise over, resignation follows, and our man decides to wait patiently for the end. A period of half lethargy was easily represented by the slowness and weakness of the man's voice while living up to this decision; but when he comes out of this sleepy condition and hears the fountain again, he is possessed with fear: he can not understand the flood he is pouring out—he dares not move—he believes he is lost. Gradually the fumes of the liquor pass away, and, his mistake being recognized, the drunkard is taken with a laughing and a gayety which are indicated by the same oath repeated in tones corresponding with the satisfaction he is then enjoying. This making the series of impressions a man passes through comprehensible by a single word, varied in pronunciation and utterance, is very like the language of animals, which is always the same, and the significance of which is given by variety of intonations corresponding with sensational conditions.

The mewing of the cat is always the same; but what a number of mental conditions it expresses! I had a kitten whose gambols and liveliness entertained me greatly. I understood well, when it came up to me mewing, what the sound meant: sometimes the kitten wanted to come up and sleep in my lap; at other times it was asking me to play with it. When, at my meals, it jumped on my knees, turned round, looked at me, and spoke in a coaxing and flattering way, it was asking for something to eat. When its mother came up with a mouse in her jaws, her muffled and low-toned mew informed the little one from a distance, and caused it to spring and run up to the game that was brought to it. The cry is always the same, but varied in the strength of the inflections and in its protraction, so as to represent the various states of mind with which my young animal is moved—just as it was with the drunken man in the mimicry scene. These facts are probably well known to all observers of animals.

We have seen that this tonality of the watch-dog's cries is

competent to indicate that a person is coming to the house. We find similar cries of warning uttered by birds. When I was a professor in the Faculty of Lille, I frequently visited the well-known aged Professor of Physics, M. Delezenne. He had a working-room at the end of a garden, in which a laughing mew wandered. From the time that any one came in till he went out, this bird made the vocal explosions to which it owes its name; and the good professor was certain, without ever being mistaken, that somebody was coming to his laboratory. He was notified. My Jaco in Paris has a warble that answers the ringing of the bell. If we have not heard the bell, we are notified by Jaco of its ringing, and, going to the door, find some one there. I have been told of a parrot belonging to the steward of a lyceum which had heard the words "Come in," when any one rang the bell. He never failed to cry, "Come in," when the bell moved, and the visitor was embarrassed at seeing nobody after having been invited to open the door.

Instances in which cries of birds had an incontestable and precise signification are numerous; let me refer to a few of the best known. The cackle of a hen, after having laid an egg and left her nest, is decidedly characteristic. Her clucking when she is impelled to sit on her eggs, or when she is calling her chicks, is no less demonstrative. There is not a farmer who does not recognize it and understand it. In these things we see the relation between the tone of the prating or cluck of the hen and her acts. But when a nightingale sings all night, or a gold-finch whistles or a raven croaks, we can not so easily interpret the significance of their inarticulate sounds. The finch calls its mate by uttering a few notes followed by a long trill. Matches, of a barbarous character based on this habit, were held in the north of France while I was living at Lille, between 1855 and 1860. I do not know whether they have been suppressed or not, but the laws for the protection of animals ought to take cognizance of them. The gamesters put out the eyes of the male finches, and made them, thus blinded, compete as singers, for which purpose they brought their cages into proximity. When the birds heard and recognized one another's voices, they made their appeal to the female; the one that renewed his amorous trills most frequently, protracted them longest and to the last, gained the prize. The bird that was declared victor received a medal amid the applause of a large and enthusiastic crowd; and considerable wagers were staked upon the result. I have heard that these poor blinded birds sometimes fell down exhausted with singing, and kept on calling the absent female till they died, not being willing to yield to a rival, who on his side was also keeping up his equally useless appeals. These finch contests were suggested

after the meaning of the song of the birds was learned. But when these birds, which are more usually isolated—whence they have been named *Fringilla cœlebs*, or celibates—hop around our houses and also utter their amorous trills at another than the mating season, they are evidently not calling the female. Should we not then seek to determine by the tone whether their call, which is always the same, is amorous or not?

In countries where flocks of turkeys are raised one can learn very quickly from their gobblings when they have captured a hare. If they meet him standing still or lying down, they form in a circle around him, and, putting their heads down, repeat continually their peculiar cries. The hare remains quiet, and it is sometimes possible to take him up, terrorized as he is in the midst of the black circle of gobbling beaks and heads. The language of the turkeys is at that time incontestably significant. It is war like, and similar to that of the males when they are fighting. In the present instance, they have joined for war, and they make it on the frightened hare.

My Jaco, like all parrots, which are excellent imitators, pronounces a few words and repeats them over and over again. Such birds amuse us, because the words they know sometimes happen to be ludicrously fitting. A bird of this kind had been struck by the note sounded by the wind blowing into a room through a crack in the glass-work whenever a certain door was opened; and he had become so perfect in his imitation that they sometimes, on hearing the noise, went to shut the door when it was not open. Jaco formerly belonged to a very pious old lady who was accustomed to say her litanies with another person. He had caught the words "Pray for us" in the invocations to the several saints, and said them so well as sometimes to deceive his learned mistress, and cause her to think she was saying her litanies with two colleagues. When Jaco was out of food, and any one passed by him, he would say, "My poor Cocotte!" or "My poor rat!" in an arch, mawkish, protracted tone that indicated very clearly what he wanted, and that his drinking-cup was empty. There was no doubt in the house as to his meaning; and whenever one heard it he said, "He has nothing to eat." He was exceedingly fond of fresh pits of apples and pears, and I was in the habit of collecting them and keeping them to give him. So, whenever, as I came near him, I put my hand into my pocket he never failed to say, "Poor Cocco!" in a supplicating tone which it was impossible to mistake. A sugar-plum is a choice morsel to him. He can tell what it is from a distance when I hold it out in my fingers; and when I give it to him he can not restrain himself if it has been any considerable time since he has had the delicacy. Usually, after having made the first motion to get it,

as if he were ravished and wanted to express his joy in advance, he would draw back before taking it, and say, in a comical tone, "Hold, my poor Cocotte!" His manner of thanking in advance is likewise amusing. The expression of his eyes and the pose of his head are all in accord with the tone of his exclamation. When he tastes the plum he utters a series of *ahs*, and produces a kind of warble by prolonging some of his notes and shortening up others. We find in these examples without doubt that the articulate voice makes us better able to judge the meaning of the impressions that are moving the animal than inarticulate cries, or merely musical sounds. When Jaco met a child for whom he had a great affection, he would promenade on his perch, or turn the wheel, spreading out his tail and ruffling the feathers of his head, while his eyes grew red with excitement if the child was too slow in bestowing the accustomed caress. Then he would stop, bend down his head, and, looking at his friend, say pleasantly, "Jaco," in a tone and with a manner quite in contrast with the pronunciation of the same word when he was hungry.

It is not the word he speaks that is of interest; he might have been taught another, and it would have been the same; but it is the tone. In this case, too, the articulation gives an easier clew to the meaning the bird seeks to express, having a meaning according to the manner of pronouncing it, than any isolated, simply musical sound, like the song of the nightingale, canary-bird, and warbler. This became evident to me, not from observing animals for a few moments without seeing them again, but from studying them continuously.

Jaco did not like solitude, and was talkative and fond of being caressed, like all of his kind. One day when there was no one in the country-house, all having gone out into the garden or the fields, I heard him saying over what few words he knew, in different inflections. I went quietly into the room where he was, without being seen; but he heard my steps, although I had walked in very cautiously, hoping to surprise him. He ceased his chatter, listened, and, after a silence, pronounced "Jaco" in a low tone, drawing out the end of the word. He listened again, and repeated the word in the same tone; then, after another silence, repeated it with a rise of the voice I continued observing him, and, as he heard no one, he raised his tone gradually, repeating the same word, and ended at last with a genuine cry of distress. The people ran in from without, supposing something had happened to him. He then repeated his name in a lower tone, which seemed to indicate his satisfaction at finding his isolation ended. I went in myself, and his prattle unmistakably betrayed his gladness at being no longer alone.

Is there not in this an act of real intelligence? While alone,

the parrot entertained himself by talking; but when he heard a sound he hoped at first to see some one come; and when no one answered him, he raised his voice, as a person would do who calls, and, getting no reply, cried out louder and louder till he was heard and answered. The meaning of the differences of intonation is as evident in this case as in that of the drunken man. A parrot raised in the south had learned to swear in the local *patois*. Being fond of coffee, he was sometimes given a spoonful, which he would come awkwardly up to the table to drink with his master. One day the master, not thinking of his bird, had already added cognac to his coffee, and gave the parrot the accustomed spoonful. The parrot took a swallow of it, and, in his surprise at the novel taste, raised his head and repeated the oath in a tone that excited laughter in all who were present. The cause of his surprise being discovered, he was soothed, and then took his usual ration with evident signs of contentment. The mimicry of language in this case clearly represented the shade of the new impression he felt.

Jaco is very timid. In the evening, when he is put to roost in a close and dark room, he is afraid of the shadow of his perch that is cast by the light we carry in our hand; he eyes it, and utters a low cry, which stops when the candle is blown out and he can not see the shadow any longer. He stands in dread of blows in the bottom of his cage, because, having a wing broken, he can not fly, and is afraid of falling. Feeling his weakness, his language has a different tone from the usual one. Large birds flying in the sky above him annoy him greatly, and we can all tell by his voice when such a bird is near or flying over. He inclines his head and chatters in a low tone as long as the bird is in sight, paying no attention to anything else. Turkeys and hens announce the approach of a bird of prey in a similar manner.

We find in the facts which we have related, as well as in many others which are cited respecting the ways and habits of parrots, proofs of a remarkable intelligence. These creatures are distinguished by the unlimited affection which they bestow upon certain persons, as well as by their excessive dislikes, which nothing can explain. Jaco conceived an extraordinary dislike for a maid who, although she took good care of him, was in the habit of washing the bottom of his cage under a faucet. He afterward discarded another person, whom he had liked so much that she could do what she pleased with him, even to passing her hand over his back and taking him by the tail, holding him in her hands, or putting him in her apron—caresses of a kind that parrots do not usually permit. Nothing astonished him or offended him. He proved very inconstant toward her, and now, while better disposed toward the other girl, he is furious against this one.

A third miss has come to capture his affection; and when he has been left asleep, or resting in his cage, he has always the same word, but different in the inflection, wheedling, angry, or nearly indifferent, as either of the three persons comes near him. Jaco's pronunciation is scanned in many metres. Only one young student has had the privilege of retaining his affection unmarred.

Jaco had been left in the country for a whole week in the winter. Alone and isolated, he was taken care of by a person who was not constantly with him. The young student, accompanied by a tutor, came to pass a few days in the house. At the sight of the youth, Jaco, surprised, called out, "Momon! Momon!" "It was affecting," they wrote me, "to see so great signs of joy." I have also myself witnessed similar signs of joy at the coming of the student. Jaco's speech at such times is always in harmony with his feelings. In the pleasant season Jaco's cage is put outdoors; and at meal-times, knowing very well what is going on within, he keeps up a steady course of suppliant appeals for attention. His appeals cease at once if I go out with fruit in my hand, and if I go toward him he utters a prattle of joy that sounds like musical laughter. These manifestations indicate that he is happy at seeing that he has been thought of.

I close these anecdotes, as I began them, by repeating that animals communicate their impressions, and the feelings that move them, by various modulations of their inarticulate cries, which are incomprehensible to us unless we have succeeded by attentive observation in connecting them with the acts that follow or precede them. We have also seen that the articulation of a few words learned by parrots aids us greatly in learning the meaning of these different inflections.

The extension of these studies would furnish much of interest; but further observations should be made upon the same animals for a long time continuously, relating especially to their peculiar instincts as manifested by their various cries. We might then, by comparing and relating acts and cries, reach the point of comprehending and perhaps fixing the meaning in many cases where we are now in ignorance. Every one has noticed a few facts, and has interpreted and related them, but much is still wanting for the co-ordination of them in the point of view of the signification of the language and communication of animals among themselves. It has not been made in a general sense.—*Translated for The Popular Science Monthly from the Revue Scientifique.*

ACCORDING to Prof. G. Brown Goode, the United States is taking a "splendid lead" in the investigation of deep-sea fishes. England, France, Italy, Switzerland, and India have all suspended their investigations, and the United States steamer Albatross represents the whole work of the world in that direction.

RECENT OCEANIC CAUSEWAYS.

By M. E. BLANCHARD, of the Institute of France.

THE object of this paper is the survey of the most remarkable changes that have taken place in the configuration of the land and the seas. My purpose is to show by an aggregation of proofs that the European and American continents were, to a certain extent, united at an epoch of only moderate geological antiquity. When we consider the extent of the Atlantic Ocean between Europe and America, as measured by the usual routes across it, we reject all thought of there ever having been a passage between the two continents in the present geological period. But the assertion of the former existence of such a communication should cause no surprise, if we regard the arctic regions of both shores of the Atlantic. In fact, if we follow a line drawn from the islands north of Scotland through the Faroe Islands to Iceland, from Iceland to Greenland, and from Greenland to Labrador through Davis Strait, which is crowded with islands and islets, we find a chain of lands interrupted only by spaces of sea of small extent, and in some places of no great depth. Subsidences of the ground and erosions have caused the isolation of lands which were united in former ages, when living Nature had assumed a character which has not ceased to exist down to our own days. A similar phenomenon produced the separation of England.

The application of natural history to physical geography and the history of the globe casts a full light upon this matter. The flora and fauna of North America are distinguished from those of Europe by essential traits. This fact contributes in a striking manner to establish the passage of a number of species from Europe to America. The demonstration appears complete when we look at the number and the character of the plants and animals inhabiting both continents. Among these are several anemones,* *Cruciferæ*,† violets, and a number of species of *Stellaria* of the pink family. The astragalus of the Alps thrives in Canada. Among the *Rosaceæ* we find a series of species of northern and Alpine Europe which occur also in North America—*Spiræas, Potentillas* and others. Numerous saxifrages, epilobiums, and honeysuckles are common, especially the famous *Linnæa borealis.* Heaths of several kinds, the rhododendron of Lapland, and primroses, have likewise found their way to America. The families of the scrophularias, the labiates, the borages, and the gentians are al-

* *Anemone gratius, A. narcissiflora,* and *A. hepatica.*

† *Cardamine bellidiflora, Arabis petræa,* and *Draba lucana.*

so represented in the New World by identical species. Among the arborescent plants, alders, willows, junipers, and the common yew exist in the cold or temperate regions of both worlds. While we refrain from dwelling on the grasses and ferns, the dissemination of which to great distances is one of the most common phenomena,* we are able to cite plants which seem hardly adapted to leap over the arms of the sea, such as orchids and lilies of northern Europe, which are also common in North America.

The numerous world of insects furnishes hundreds of examples of species that have passed across from the arctic regions of Europe into America. Of the beetles, insects generally sedentary and possessed of means of locomotion so inferior that they would hardly venture to cross a sea with them, we can mention not less than three or four hundred species as common to both continents. We are particularly struck with the number of carnivorous species (*Carabides*), which, living on the land and hiding under stones, are disseminated very slowly. These species of carnivorous *Coleoptera* may be followed from the north of the European continent to Iceland, the shores of Greenland, Labrador, and Canada.† It would be absurd to suppose that man has been able in his migrations to carry such a multitude of the lower creatures across the ocean. Notwithstanding the daily chances and the continual transportation of all kinds of food-products, the common chafer of Europe has not been introduced at any point in North America.

Lepidopterous insects (butterflies and moths), aided by a favorable wind, are undoubtedly sometimes carried over the sea; and it is not impossible that when they fall upon a land remote from the country of their origin they may live and propagate themselves there. These, however, are exceptional cases, while the *Lepidoptera* of the New World may be counted by the legion. The common vanessas of Europe abound in the northern parts of America,‡ and the argynnes of Lapland and Iceland* and the satyrs of the genus *Chionobas* live also in Labrador. The enumeration could be easily extended.

It is fair to suppose that investigations properly directed would enable us to recognize, in some American forms very close to the European, local varieties of the same species. It may

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* M. O. Franchet, a botanist attached to the Museum of Natural History, has made, at my request, a complete examination of the plants of northern Europe which are diffused to a greater or less extent in North America.

† *Blethera arctica, Nebria nivalis, Bembidium Grapei, Patrobus septentrionis, Pterostichus vitreus, P. arcticola, Amara erratica, A. interstitialis, A. brunnea, Platyrus Bogemanni, Miscodera arctica.*

‡ *Vanessa antiopa, V. Paolychlorus, V. Urtica, V. Atalanta.*

* *Argynnis Freya, A. Frigga.*

be further observed, in support of our thesis, that species incapable of great displacements, such as the spiders of arctic countries and Alpine regions, have been observed in Greenland. We can furthermore draw valuable results from the survey of the geographical area of various vertebrates. The common marten, the common sable, and the ermine of the cold countries of Europe, have passed into North America. Specific differences between animals existing in different countries were formerly made too readily, but we are now more careful. A very characteristic type—the beaver—is widely diffused in Europe and in Canada. The differences which the old naturalists defined between the European and American beavers are of the most superficial character, while contemporary zoölogists only distinguish local varieties. Other rodents, like the Norwegian lemming and the variable hare, have followed the same ways as the preceding species, and spread themselves from one continent to the other. Finally, we must not forget the reindeer of Lapland, which also wanders in numerous troops in the coldest regions of North America.

The fresh-water fishes of North America constitute a group very characteristic of a single region of the globe. Yet this fauna is augmented by a few European species. A perch (*Perca flavescens*) should not apparently be separated from the river perch of Europe. The peculiarities in the number and proportions of the spines that garnish the opercle are so variable in individuals that specific distinctions can not be based upon them.* The European river bull-head (*Cottus gobio*), which is spread through all northern Europe, lives in Greenland and North America. The European pike inhabits the fresh waters of North America, along with a distinct species peculiar to the country. Now, it is certain that no river perch or bull-head or pike ever left fresh water. These fishes could therefore have distributed themselves through the two continents only at some time when the lands scattered between the Old and New Worlds were connected.

So abundant are the proofs of a communication by land between Europe and America during a recent age of the earth, that it does not seem too presumptuous to declare it clearly certain.

If we carry ourselves back to the views which prevailed till recently concerning the isolation of America, we shall suffer a kind of surprise in observing most striking resemblances in living

* At my request, M. Léon Vaillant, my colleague in the Museum of Natural History, has examined all the specimens of the American perch (*Perca flavescens*) in the collections of this museum and compared them with the river perch of Europe. The recognized differences are of so little importance as in no way to authorize a specific distinction.

Nature on the two continents. The union between the continents probably existed only in the north, perhaps above the fiftieth degree of latitude. If we follow the most eastern parts of Asia, northern Japan, Siberia, and Kamchatka, which are separated from America by Bering Strait, or if we proceed from the American side through the peninsula of Alaska and the chain of the Aleutian Islands, we shall comprehend at once that only very ordinary geological changes may have been sufficient to bring about the separation of lands which had been long united. Looking toward the extreme north, we find no other separation between the Old and New Worlds than a simple arm of the sea, Bering Strait.

The study of living Nature in the arctic regions of Asia and America is very instructive. Let us begin with examining the vegetation. Some anemones and a ranunculus* of Siberia are now common in North America. Another species of ranunculus† is common to Japan, Kamchatka, Alaska, and northern and eastern America. While we admire the tulip tree‡ in the parks of Europe, we recollect also that that beautiful exotic is one of the glories of the North American flora. But the tulip tree has recently been discovered in China. Then, there are the violets of Siberia and Japan,# which are mingled also with the vegetation of North America; and a vine (*Vitis Labrusca*), now well known, reputed American, which grows in Japan and a part of eastern Asia. A maple‖ is common to Japan and North America, as are also *Spiræa betulifolia* (birch-leaved spiræa) and *Potentilla fragiformis* of the rose family, some saxifrages, a crassula (*Penthorum sedoides*), various umbelliferous plants, the maritime alder, and a few orchids and lilies.

The animal world furnishes valuable evidences of our theory. Concerning insects I will cite only the facts most demonstrative of former communications. Some carnivorous beetles, the Carabs,^ insects remarkable for their forms and colors, wingless, and having only their legs as means of locomotion, inhabitants of eastern Siberia, are also found in the cold countries of North America. I first saw collections made in California, after I had already become familiar with the faunas of Europe, Asia, and America. I was then surprised to see in those collections European and Asiatic forms which were believed to be entirely foreign to America. A little French butterfly, also occurring in Siberia, the valley of the Amoor, and Japan, was found on the western coast of America. It appears to be unique in the color of its wings, which are beautifully green on the lower sides. The like-

* *Ranunculus cymbalaria.* † *Trautvetteria palmata.* ‡ *Liriodendron tulipifera.*
# *Viola rostrata, V. Canadensis.* ‖ *Acer spicatum.*
^ *Carabus Vielinghosi, C. meander, C. truncaticollis, Cychrus angusticollis.*

ness was most striking. Yet an entomologist, resting on trifling peculiarities hardly the signs of a variety, described it as a new species.* It is impossible to admit this. It was then learned that the genus *Parnassius*, which were believed peculiar to the mountains of Europe and Asia, existed in California. The species were distinct from those of the Old World; according to the conventional expression, they were typical species. Afterward a species of the same genus was observed on the western coast of North America which was regarded as peculiar to Siberia and Mongolia.† *Papilio Hippocrates*, a butterfly of a remarkable type, which was known in Japan, has been found in North America.

Passing to vertebrate animals, I confine myself to the mention of a small number of most characteristic types. Among the rodents we remark the marmot, *Arctomys pruniosus*, or sonslik of Siberia, which lives in Kamchatka, on the Alaskan Peninsula, and on the American continent. Among all the carnivorous animals of the family of the *Mustelidæ*, or weasels, we remark the sable of eastern Asia in Kamchatka, Alaska, and other northern parts of the American continent. A carnivorous animal of another group, the glutton, or wolverine, is found in the same regions.

In this latter part of my paper I have spoken wholly of animals and plants common to Asia and America, as in the former part I spoke only of those common to Europe and North America. But while I omit to make long enumerations of species, I insist on the fact that plants and animals are distributed in considerable numbers over the whole extent of the arctic regions in Europe, Asia, and America, having accomplished the whole circuit of that zone at an epoch when the continuity of the land made possible an indefinite dissemination to the full extent that climatic conditions were favorable.

With the present condition exactly determined, and the former condition recognized, a sure foundation is laid for the science of the future; new changes will be produced in the course of a few centuries in the configurations of the lands and the seas, and then men of science will be able to form theories of value.—*Translated for The Popular Science Monthly from the Revue Scientifique.*

THE work of searching for the affinities of great groups is declared by Prof. Coulter to be the crying need of systematic botany. There is danger of magnifying the importance of certain periods or organs in indicating affinities. For the best and most permanent results of systematic botany, it should take into account development at every period and of every organ, and so obtain a mass of cumulative evidence for safe generalization.

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* The *Thecla rubi* of Europe and Asia; the California specimens were described under the name of *T. dumetorum* (Boisd).

† *Parnassius Nomion.*

THE UNIVERSE OF STARS.*

IT is only, curiously enough, within the last decade or two that the science of astronomy has answered to its name. Until the methods of spectrum analysis and of photography were applied to the stars, astronomers were scarcely justified in their title, for they knew little about the stars, and, hardly hoping to know more, almost confined their attention to the solar system. Now, although sidereal astronomy, the science of astronomy *par excellence*, is still in its infancy, we may discern pretty clearly what will be the nature of its achievements. Surpassing the wildest dreams of the older astronomers in range and penetration, modern astronomy yet brings the whole cosmos within the grasp of human intelligence. Not only are the stars in process of being numbered, their motions, proper and relative, in course of measurement, their physical constitution subjected to analysis, and their distances brought within computation; but the entire sidereal system is recognized as limited in extent, and the form and magnitude of the vast group in space will at no distant date become susceptible of approximate delineation and calculation.

Of the methods referred to, photography has had, perhaps, the largest share in the recent advancement of sidereal science. The chemistry of the stars, it is true, is founded wholly on spectrum analysis, that profound and searching means of testing the composition of bodies by the action of elementary substances, under proper conditions, upon the infinitesimal undulations which give rise to the phenomena of light; but without the aid of photography, the mapping of star-spectra must have remained a slow and inaccurate process. The camera, on the other hand, has revealed almost all that is known concerning the number, distances, masses, and motions of the stars; the lens has no "personal equation," and never gets tired; sensitized gelatin responds with infinite celerity to the undulations which make no impression whatever upon the eye; and star-pictures of the heavens are not only permanent records, but, with the proper instruments and skill, can be so readily taken that before very long it is probable that some seven hundred thousand out of the whole sixty millions of stars will be accurately charted and indexed.

For such is the least number of the heavenly host—which a French astronomer somewhat extravagantly estimates to contain nearly seventy thousand millions of suns; for each star we see is a sun shining with its own light, and governing probably, like our own, the motions of a system of planets. Nor is the light

* The System of the Stars. By Agnes M. Clerke. London: Longmans. 1890.

they send us inconsiderable, for the total effulgence of the stars down to the 9½ light-magnitude is equal to one eightieth part of the effulgence of a full moon in a clear sky. What light we get from the stars of lower magnitude it is difficult to say, but it is clear that the stellar world is not boundless, for were it so the light from the infinite hosts of more and more remote suns would, as Miss Clerke says, fill the sky with an indefinitely intense radiance. It must, however, be remembered that it is not known whether the undulations which cause light are capable of infinite propagation. Nor, it may be added, can one be certain that the mass of ether in which our cosmos swims is the only one in space; or, if space and ether be taken as convertible terms, that it is the only mass differentiated—coarsened, so to speak, into a condition fit for the evolution of matter and energy, and of the suns and solar systems thus brought into being. The stars are arranged according to their light-magnitudes, to each magnitude the numerical value 2½ being assigned, for mathematical reasons that can not be here explained. Altair and Aldebaran are, strictly speaking, the only stars of the first magnitude, and the light of either of them would equal that of one hundred stars of the sixth and one million stars of the sixteenth magnitude. Sirius, however, is nine times as bright as Aldebaran, and its magnitude accordingly is expressed by the value −1·4. Among the suns visible to us, it comes next to our own sun, whose magnitude is reckoned at −25·4; in other words, the sun is (to our earth) between three and four million times as luminous as the Dog-star. The most accurate photometric measures of the stars are now made by the aid of photography, and the astronomers of a thousand years hence will have before them exact light-histories of nearly all the millions of stars of which the delicate and tireless gelatin films can seize and retain the faintest light-impressions. To what undreamed-of knowledge of our cosmos this wealth of accurate records will lead!

One of the most important results of stellar photometry is the aid it affords toward determining the distances of the stars. The mean distance of stars of the same magnitude is approximately the same; and if, therefore, the distances of some of the nearer stars are obtained, the approximate remoteness of any given category is easily calculated. But to find independently the distance of any individual star, its parallax must be known—the angle, that is, between two lines drawn from the ends of a base-line of known length to the star in question. Now, if the mean distance between earth and sun be taken as such base-line, 93,000,000 miles in length, to include an angle of one second (one 324,000th of a right angle), the line must be drawn to an object 206,265 × 93,000,000 miles distant. Well, *no star is so near as this.* The nearest star,

α Centauri, has a parallax of three fourths of a second. To bring within easier comprehension the enormous distance this parallax involves, let the rapidity of light be considered. Light travels at the rate of over one hundred and eighty thousand miles a second, and a year of such travel may be taken as a unit for star-distances. Thus, the distance of α Centauri would be measured by nearly 4½ "light-years." The Polar Star is forty light-years, Sirius one hundred and twenty-one light-years, distant from our globe; while stars of the sixteenth magnitude may be so remote that it would take a wave of light thirty-six thousand years to reach the solar system. The parallax of Sirius is only about one thirty-third of a second—a striking example of the dependence of the most prodigious measurements of astronomy upon the minutest readings of apparatus, necessitating the utmost perfection of workmanship, as well as consummate skill and knowledge on the part of the observer.

Over eight thousand nebulæ have now been subjected to examination. The great nebulæ in Andromeda and Orion are, of course, familiar to every one. The telescopic nebulæ are of all sizes and shapes, and scattered over the whole heavens. Many stars have nebulous wisps and whirls, tails and helices, attached to them. The nature of nebulæ is still more or less of a mystery. But it is certain that they are initial, or at least early, phases of the life-history of stars. That life-history may be shortly stated in Miss Clerke's own words:

> By the ceaseless advance of condensation nebulæ are transformed first into gaseous stars (showing bright lines in the spectrum, and therefore shrouded in glowing atmospheres, chiefly of hydrogen and helium), then into stars with banded spectra (showing outer atmospheric strata below incandescence over inner strata at glowing heat), from which (by further condensation and increase of inner heat below irregular outer clouds of metallic vapor) solar stars, and from these again Sirian stars, gradually emerge. Here the ascent ends; the maximum of temperature is reached, and a descent begins, the initial stage of which is marked by a second group of objects like our sun and Capella, distinguished from the first by the circumstance that they are losing instead of gaining heat; while, lower still, the condition immediately antecedent to solidification and obscurity (dark stars) is represented by Father Secchi's "carbon stars."

The nebula in Orion is of a very irregular shape; imbedded in it lies the stellar group θ^1 of the constellation, and some other stars, all of which together seem to form an enormous system whose dimensions can scarcely even be guessed at. Examined by the spectroscope, the nebula is found to consist of glowing gas, which the spectrum indicates to be a mixture of hydrogen and nitrogen. The Andromeda nebula, on the other hand, presents a well-defined oval, and gives a continuous spectrum in which no bright lines have been certainly distinguished. It may, therefore,

be not a nebula at all, but a cluster of stars so enormously remote as to be unanalyzable by the most powerful of modern telescopes. In relation to nebulæ, a word may be said on Mr. Lockyer's ingenious "meteoric theory," submitted to the scientific world in 1887. Nebulæ, he asserts, "are composed of spare meteorites, the collisions of which bring about a rise of temperature sufficient to render luminous one of their chief constituents, magnesium." But the spectroscopic coincidences upon which this theory is based are by no means verified, nor has any comprehensible theory of the origin of these meteorites—very complex bodies, according to the samples that have reached our earth—been offered. If, following the indications of recent chemical and physical research, we consider the elements as molecular differentiations of the ether, the nebulæ may present stages in this differentiation in which the molecular states of some of the elements are not identical with those with which we are familiar in the laboratory, in which, indeed, certain of the elements may not yet have been evolved.—*The Spectator.*

SKETCH OF WILLIAM EDWARD WEBER.

WITH the death of Weber, June 23, 1891, passed away, as M. Mascart, of the Central Meteorological Bureau of France, has well said, the last representative of that generation of men of science that cast so much luster on the first half of this century. He was also the last survivor of that group of experimenters in Europe and America whose labors gave the world the electric telegraph; the one among them who first demonstrated that communication by electricity was possible and practicable.

WILLIAM EDWARD WEBER was born in Wittenberg, Prussia, October 24, 1804. He was the second of three sons of the learned theologian, Michael Weber, Professor of Theology at Wittenberg. The other two sons became doctors, both contributed to science, and both co-operated with the subject of this sketch in some important investigation. Weber studied at the Frankean School and the University of Halle, received his doctor's degree in 1826, became privat-docent at Halle in the next year, and Professor-Extraordinary of Physics there in 1828. In 1831 he was appointed to succeed John Tobias Mayer as Professor of Physics in the University of Göttingen. He remained there till 1837, when a political event caused his retirement. On the death of King William IV of England and Hanover, the kingdom of Hanover was separated from England by the operation of the Salic law, and fell to Ernest Augustus, Duke of Cumberland, uncle of King

William. Ernest was a believer in the supreme right of kings, and set aside the Constitution which William had granted in 1833. At the same time he called on the public officers of the country, including the professors in the university, to take an oath of allegiance to him and of obedience to his new rule. Weber with six of his fellow-professors — Jacob and William Grimm, Dahlmann, Albrecht, Gervinus, and Ewald — protested against the arbitrary act, and refused to conform to it. "The entire effect of our work," they said, "depends not more surely on the scientific value of our teaching than on our personal freedom from reproach. So soon as we appear before the students as men who trifle with their oaths, our efficiency is at an end. And what would the oath of our fidelity and homage be worth to his Majesty the King, if it came from men who had just frivolously set aside another sworn obligation?" For this refusal the seven professors —"the Göttingen seven" they are called—were removed from their chairs, and three of them (Gervinus, Dahlmann, and Jacob Grimm) were expelled from the country. After this event Weber lived in retirement as a private teacher in Göttingen till 1843, when he was called to be Professor of Physics in the University of Leipsic. According to a German biographer, he never felt quite at home in Leipsic, and gladly accepted an invitation in 1849 to his old place in the Georgia Augusta at Göttingen, where he spent the rest of his life, "with rare fullness of enjoyment pursuing his learned work, never anxious about the show of success, but finding complete satisfaction in the peculiar joys of scientific achievement, furnishing thus a shining example in opposition to the restlessness of our age."

With his eldest brother, Ernst Heinrich, who, a physician, with particular devotion to anatomy and physiology, had become interested in the solution of certain difficult questions in physics, Weber engaged in the investigation of some of the phenomena of wave-motion. The result was the publication, in 1825, when Weber was twenty-one years old, of the book *Die Wellenlehre auf Experimente gegrundet* (The Doctrine of Waves, based on Experiments), a volume of five hundred and seventy-four pages, with eighteen copper plates, mostly engraved by the authors. One of the striking results of the investigations was the discovery that, when a regular series of waves follow each other along the surface of water, the particles at the surface describe vertical circles, the plane of which is parallel to the direction of propagation of the waves, and those lower down ellipses, of which the vertical axis becomes smaller and smaller with increasing depth. The work was, according to the declaration of the authors, the result of such constant and intimate communication between them with regard to all the parts that it was impossible to assign

to either of them the separate authorship of any distinct portions.

A few years afterward, at Göttingen, Weber was engaged in another investigation with his brother Eduard Friedrich, who was also a doctor interested in physical studies, of the mechanism of walking, the results of which were published in the book *Mechanik der menschlichen Gehwerkzeuge*. The salient feature of this work, in which many novel facts were brought out, was the enunciation of the fact that the pressure of the air is a factor in holding the bones in place in the joints.

For several years Weber was occupied mainly with questions of acoustics, on which, as well as upon electricity, heat, and light, he published many important papers.

His title to be regarded as one of the masters in science rests chiefly on his researches in electricity and magnetism. His position as professor at Göttingen brought him into close association with Gauss, who was as devoted to mathematics as Weber was to physics. The two assisted and complemented one another: Weber needed calculations to bring out the bearings of his experimental results, and Gauss was ready to take up any serious problem that needed solution.

Gauss, according to M. Mascart, besides his work in analysis and celestial mechanics, had given his attention to the mathematical theory of electricity and magnetism, in which he found many analogies with that of universal attraction. He had published a memoir describing an experimental method superior to that of Coulomb for verifying the law of magnetic actions, and a general theory of the magnetism of the globe and the relations between the results obtained at different stations. He established a magnetic observatory, where the methods of calculation he had devised were applied; and with Weber's collaboration an extensive association was formed, including the directors of the principal observatories, chiefly in Germany, for making a systematic study, under a common plan, of the continual variations of terrestrial magnetism. The results of this great enterprise were published by Weber from year to year, and collected in a magnetic atlas of the globe. In memory of this initiative, the Meridian of Göttingen is still preserved as the point of departure in a large number of general studies on the distribution of terrestrial magnetism. This common labor led to the installation, by the two co-workers, in 1834, of the first electric telegraph, by which an important date is marked in the history of telegraphy.

The idea of telegraphing by means of electricity was not entirely novel then. Samuel Thomas von Sömmering, of Munich, had experimented upon it with some success in 1809. Ampère, in 1820, and Fechner, in 1829, had proposed the utilization of the magnetic

needle for making signals. But none of these efforts had advanced beyond the experimental stage, and they were only of historical value. They illustrate the general principle that a great discovery hardly ever springs from the thought of a single man. But the fact that there were preceding tentatives does not diminish the fame of the man who gathers up and combines the previous results and completes what they had left unfinished. Weber was the first who established a permanent workable telegraph line, and thereby demonstrated the practical value of the electric telegraph. Weber's house in the city was connected with the astronomical and magnetic observatories by a line between three and four kilometres (over two miles) in length. The signals were made by the deviations of the needle of a galvanometer to the right and left and were interpreted according to a conventional alphabet. The use of interrupted or reversed currents did not permit the transmission of more than one or two words a minute, but the speed was increased to seven or eight words by the use of induced currents.

The following first notice of this telegraphic connection was published in one of the numbers of the *Göttingischen gelehrten Anzeigen* (or Göttingen Scientific Notes) for 1834: "We can not omit to mention an important and, in its way, unique feature in close connection with the arrangements we have described [of the Physical Observatory], which we owe to our Prof. Weber. He last year stretched a double connecting wire from the cabinet of physics over the houses of the city to the observatory; in this a grand galvanic chain is established, in which the current is carried through about nine thousand feet of wire. The wire of the chain is chiefly copper wire, known in the trade as No. 3. The certainty and exactness with which one can control by means of the commutator the direction of the current and the movement of the needle depending upon it were demonstrated last year by successful application to telegraphic signalizing of whole words and short phrases. There is no doubt that it will be possible to establish immediate telegraphic communication between two stations at considerable distances from one another."

Weber's general magnetic and electrical researches, by which his place in the history of science is most conspicuously marked, are described in the *Resultate aus den Beobachtungen des magnetischen Vereins* (Results from the Observations of the Magnetic Union), published by Gauss and Weber from 1837 to 1843, and in Weber's *Elektrodynamische Maasbestimmungen* (Electrodynamic Measurements), published from 1846 to 1874. Of these, M. Mascart says that "the thought of measures in mechanical unities was naturally applicable to the reactions which take place between conductors traversed by electric currents and between cur-

rents, the laws of which had been established by Ampère for the permanent effects, and by Faraday for the transient effects produced by currents of induction. Weber found in them a new road and a personal glory. The series of memoirs in the *Elektrodynamische Maasbestimmungen* constitute an imperishable scientific monument, in which the extent of the descriptions may sometimes appear long to the reader eager to get on, but the attentive study of which is ever fruitful. It is impossible to give an adequate estimate of this work in a short analysis; we shall only point out a few of its salient traits. The invention of electrodynamometry, which depends on the reciprocal action of currents, permitted Weber to subject Ampère's law to a vigorous testing by a method that differed from that of Gauss only by the substitution of coils for magnets. The close study of the deviations produced in galvanometric apparatus by permanent or temporary currents furnished him with a means of devising precise methods of observation, of measuring quantities of electricity corresponding to the discharge by the impulse impressed by them on the magnetic needle, and of estimating the approximate duration of the discharges by a combination of the galvanometer and the electrodynamometer.

In the course of his experimental researches, Weber made known an important formula which includes in a single expression Coulomb's laws of electrostatics, Ampère's laws on the reciprocal action of currents, and the phenomena of induction described by Faraday. Gauss seems not to have been a stranger to the selection of this formula, and the theoretical conceptions which are its basis may give occasion to discussion; but Weber has the merit of having shown all its consequences by establishing for the first time a close connection between phenomena that appear independent. Weber's labors are particularly distinguished by the introduction of the absolute measures which have contributed for several years to the rapid progress of electricity as a subject of pure science and in its industrial applications. To him, in fact, we owe the suppression of a vague terminology in which currents were estimated by the kind of piles and number of couples, the length and size of circuits, or the deviation produced in a dynamometer of which only the number of turns of wire was indicated. The inestimable services that have been derived from the employment of absolute measures justify the attribution of the name of *weber* to the unity of the current as defined by its electromagnetic action, for which the mechanical unities of Gauss —the millimetre, the milligramme, and the second of mean time —are adopted.

Weber's biographer in Nature gives Sir William Thomson the credit of having been one of the first men of science to recog-

nize the fundamental character and far-reaching importance of Weber's work; and, owing mainly to his clear-sighted advocacy of the absolute system of measurement, this system was from the first adopted as the basis for the operations of the British Association Committee on Electrical Standards, appointed originally in 1862. "This system has now become so familiar to electricians, and is taken so much as a matter of course, that it requires some mental effort to recall the state of science when it did not exist, and to appreciate the intellectual greatness of the man to whom it is due. If we consider method and point of view, rather than acquired results, it is not too much to say that the idea of absolute measurements, underlying as it does the conception of the conservation of energy, constitutes the most characteristic difference between modern physics and the physics of the early part of our century. And to no one man is so large a share in this great step due as to Wilhelm Eduard Weber."

Weber, in conjunction with Kohlrausch, determined the relations between electrical and magnetic measurements expressed in the same unities, concerning which there seems to have been some confusion. He determined the chemical actions by electrolysis which correspond with the passage of a unity of current in a second, and by this furnished a practical means of reconstituting that unity in experiments. He pointed out and put in practice some of the most precise methods for determining the numerical value, as related to the fundamental unities, of the electrical resistance of a conductor. His name is also associated with numerous labors for fixing the value of the practical unity of resistance, or the ohm, in terms of the mercurial column.

So retired was Weber's life in his later days that, though his fame had not diminished, the world had almost forgotten that he was still in it; and it is said that when, at the meeting of the German naturalists in Berlin a few years ago, the name of Weber was read in the list of those who had taken part in the first meeting held there in 1828, surprise was expressed at recognizing in their octogenarian friend one who had sat there with Berzelius and Ohm and Heim.

Weber was a corresponding member of the Institute of France, and had been a foreign member of the Royal Society since 1850.

EDITOR'S TABLE.

UNIVERSITY EXTENSION AND THE STATE.

THE writer of the able article on university extension which appeared in the November Monthly, does well to come forward in the present number and further develop his views as to the best means of securing the success of the university-extension movement. He does not agree with the opinion we expressed in the "Table" for November, that the movement in question should be carried on in entire independence of Government assistance. He thinks, on the contrary, that, unless the national Government comes to its aid with a grant of money, the work which is proposed "can not be thoroughly or systematically done as regards the country at large"; and he takes occasion to indicate what he considers to be the true theory of the state. The arguments of our valued contributor, we must say, have not convinced us; and, considering the importance of the subject, we feel sure that we shall be excused if we say a few more words upon it from our own point of view.

The university-extension scheme, we must assume, has been called into existence to meet a public demand. Prof. Henderson says: "The work promises to be much too large for private enterprise." We interpret this to mean that there is a great and growing interest in the extension movement—that the public are, to an encouraging extent, alive to its importance; but, if such is the case, instead of saying that the work promises to be "much too large for private enterprise," we should say that private enterprise bids fair to cope most successfully with the work. If public interest has not been awakened in an encouraging degree, we fail to see the force or propriety of the word "promises" as used by Prof. Henderson; if it has been so awakened, we say, let us wait and see what public interest and private enterprise will do before we dream of asking for a share of the taxes to support the movement. We are strongly of opinion that people should pay for the bread of intellectual life. If they pay for it they will value it, and not scatter it by the roadside, as beggars do bread given in alms. There is invariably far more intellectual interest in a class all the members of which pay the full amount of their own fees; the attendance is more regular, the attention is more keen. Every one can verify this from his own experience. A traveling teacher or professor visits a town or village and offers to teach a class of so many some particular subject at so much a head. If the class is formed, every one, as a rule, does his or her best to get the most out of it. Nobody goes there to trifle, nobody cares to miss a lesson. Now, what university extension has got to do is to offer the people what they want in the way of instruction and invite them to pay for it. If it offers the people what they do not want they will not take it; and here we see one of the mischiefs of Government interference. Why have the old universities of the world been so slow to move out of their ancient ruts, so slow to adapt their teaching to the new requirements of a new age? Simply because they have had large endowments and have been to that extent independent of public opinion. If a certain subject declined in interest, the university could go on teaching it to all but empty benches. The endowment was there, the chair was provided for, and why should any change be made? Precisely so with our university-extension movement: backed by Government money it would inevitably be less swayed by considerations of public utility, and more by the estab-

lished conventions, not to say fictions, of the teaching profession, than if it were wholly dependent on the free response of the public.

Another objection that we make is that the idea of using the proceeds of taxation in aid of the movement gives it too indeterminate a character. Prof. Henderson's own language shows this. "Once established," he says, "these district central offices of the Department of Education might, with perfect propriety, go a step further and provide, under suitable conditions, for part of the expense of an extension course where the proceeds from the sale of lecture-tickets were not sufficient. With the people themselves directly creating each center, electing their own subject, choosing their own lecturer, and paying for *all or part* of the local expense, I really do not see how the movement could become commonplace or mercenary in its character by being systematized under national auspices." The words we have italicized are significantly vague. Will it be pretended, besides, that the agency disposing of the Government grant would not have a great deal to say as to the mode of its application, and would not, in many cases, override local choice as to subjects and lecturers? If of two localities, both aspiring to the grant, one fell in with all the views of the district center, while another stood out for some plan of studies of its own, can any one doubt that the tractable locality would have much the better chance of getting it? Another point is that as soon as it became a matter of distributing Government money, all kinds of local jealousies would arise; and politicians would appear upon the scene to demand that their special localities should not be neglected. We incline to think that, if Prof. Henderson could only be brought into contact with two or three average Congressmen wrangling over what they would regard as a division of the spoils, his confidence in the beneficent influence of a subsidy would be somewhat shaken.

We do not know how our contributor arrives at the induction he puts forward with so much confidence that "the sum of American public infamy is neither absolutely nor relatively so great as the sum of American private infamy"; but we must be allowed to question the value of the formula. We are told that the Government is corrupt only because the people are corrupt. There is doubtless some general truth in the statement; but it ought not to be forgotten that one way in which the corruption of the people shows itself is in taking money in taxes which they could not get in any other way, and to which they have no right. Appropriation-hunting has long since been reduced to a science, and no one who has carefully watched the politics of this or any other democratic country can doubt that every additional appropriation made by the Legislature becomes to some extent an additional corruption fund. Granting even that the appropriation once voted is honestly expended as a matter of account, the very granting of it in many cases was an act of theft viewed from one side and an act of bribery viewed from another. The locality or interest that clamors till it gets what it wants, without regard to the general welfare, virtually steals; and the combination of politicians that procures the appropriation aids in the theft for purposes of bribery. To say, therefore, that such money does not stick to the hands of the officials who expend it is not saying much. They doubtless, as Prof. Henderson hints, are more or less compelled to be honest—the dishonesty was perpetrated in the passing of the vote by which the money was obtained in the first place. When Prof. Henderson tells us that our officials are not so bad, and that we should not be afraid of the Government which is our own creature, he misses the mark. We are not afraid of the officials, whose functions are

largely analogous to those of employés in private firms or corporations; what we are afraid of is the really irresponsible action of our legislators who are sent to Congress almost solely as representatives of local interests, wholly unembarrassed by local consciences. Our real *Government* is not the executive—it is the Legislature; and if Prof. Henderson will take the responsibility of stating that the private business of the country is carried on on less honest principles than the business of legislation, we think he will surprise most well-informed readers.

We must demur altogether to Prof. Henderson's identification of liberty with *power* or *faculty*. If a man can not swim, we do not say he is not at liberty to swim. If, on the other hand, a boy *can* swim, but is not allowed to by his parents, we say he is not at liberty to swim. The business of Government, according to Herbert Spencer, to whom Prof. Henderson refers, is to protect individuals in the exercise of already acquired faculties and powers, not to take measures for enlarging their faculties and powers: that, he holds, they should look after for themselves. Liberty means nothing else than freedom from external restraint; and to assume, as Prof. Henderson seems to, that a man free from external restraint is not truly free unless he has also a wide range of action is about as logical as to say that a man can not be truly sane unless he has a very wide range of knowledge. Yet it is on the strength of this apparent confusion of thought that Prof. Henderson asks us, in the name of liberty, to intrust the Government with a great diversity of functions for the purpose of "making desirable individual action possible"! We sincerely trust that university-extension lecturers will not be found teaching this doctrine, and arguing that a man's freedom is increased when he gets cheaper postage, or any other added facilities for action. In the sense in which Prof. Henderson is using the word "liberty," it would surely be the duty of the Government to see that every man was well supplied with pocket-money, since nothing so circumscribes action as poverty.

Finally, we fail to see much force in the paragraph in which our contributor sums up his case: "A governmental action which compels is mischievous; an activity which says, 'Thou mayst; lo! here are the means,' is helpful." Surely it is obvious that before the Government can say "Thou mayst; lo! here are the means," it must have taken those means from somebody else. The one great form of compulsion which governments nowadays have it in their power to exercise is this one of taxation. The business of Government is not to say "Thou mayst" to any one, but to say "Thou must *not*" to every one who shows a disposition to encroach on the liberties of his neighbor. "Thou mayst" in the mouth of the Government is almost, if not quite, an impertinence. "Thou must not," if uttered in the right quarter, is the watchword of individual liberty.

LITERARY NOTICES.

THE CAUSE OF AN ICE AGE. By Sir ROBERT BALL, LL. D., F. R. S., Royal Astronomer of Ireland, author of Starland. Modern Science Series, Vol. I. New York: D. Appleton & Company. 1891. 16mo. Pp. xii+180. Price, $1.

As a mathematician, Dr. Ball has a high reputation, and he has at the same time rare ability in popularizing his themes. Even those who have little mathematical knowledge will find no difficulty in understanding the main points of this volume, while the abstruse formulas upon which his theory depends are relegated to a short appendix, where they can be examined at leisure by those who are competent to carry on extended mathematical calculations.

In his opinion, the discovery which Dr. Ball has made lends strong support to the theory of Adhémar and Croll, namely, that the great Ice age was produced by the precession of the equinoxes during a period of

an extreme ellipticity of the earth's orbit. The sun is now about three million miles nearer us in the winter than in summer, and the winter (that is, the time from the autumnal to the vernal equinox) is seven days shorter than the summer. In about eleven thousand years from now the condition of things will be reversed, and the northern hemisphere will have a summer seven days shorter than the winter, occurring while the earth is three million miles nearer its source of heat. About two hundred and fifty thousand years ago the eccentricity of the earth's orbit was so great that the difference in these seasons was thirty-three days, and the difference between the distance of the earth from the sun at perihelion and that at aphelion was seven or eight million miles.

These facts served as the basis for Mr. Croll's theory, who assumed, on the strength of Herschel's authority, that the absolute amount of heat received by the earth during the season which occurred in perihelion was the same as that received during aphelion. He reasoned, therefore, that when the winters occurred in aphelion both their increased length and the greater distance from the sun would favor the radiation of heat to such an extent that a glacial period would be produced, especially in those periods when the eccentricity of the earth's orbit was greatest. Dr. Ball comes to the aid of Mr. Croll by showing that the distribution of heat between summer and winter is not in equal quantities, as supposed by Mr. Croll, but that sixty-three per cent of the annual heat received by a hemisphere of the earth falls upon it during the summer—that is, from the vernal to the autumnal equinox—and only thirty-seven per cent during the winter. If, therefore, there was any truth in Croll's original theory, Dr. Ball's discovery will greatly increase the efficiency of the cause.

But the accumulating objections urged by geologists against the theory of Mr. Croll must still apply with all their force. For after Dr. Ball's amendment there is even greater demand than before for geological evidence of a long succession of glacial periods, especially during the later geological eras. But it is the universal opinion of geologists that the Tertiary period was throughout one of great mildness of climate, even up to the vicinity of the north pole; yet the Tertiary age doubtless stretched over more than one period of extreme eccentricity of the earth's orbit. Furthermore, the point of glacial radiation in North America is not the north pole, but the region south of Hudson Bay. So clearly is this the case, that President Chamberlin (who has charge of the glacial department of the United States Geological Survey) has adopted the theory that the cause of the glacial phenomena of North America was an actual change of the position of the pole; while others, who can not give their adherence to so improbable a cause, are laying renewed emphasis upon the changes of level in the earth's surface which occurred toward the close of the Tertiary period.

While, however, we are not convinced of the adequacy of Croll's hypothesis, even as amended by Dr. Ball, we can speak most highly of Dr. Ball's work in bringing clearly before our minds a possible astronomical cause for the Glacial period with which all students of this attractive subject must reckon. The defect in the theory lies not in the mathematical calculations, but in our real lack of knowledge concerning the causes which distribute the heat over the surface of the earth. Meteorology is the science to which we look with most expectancy for further light upon the cause of the Glacial period. The astronomical causes suggested by Dr. Ball's discussion may be so readily masked by slight changes in the direction of oceanic and atmospheric currents produced by relatively slight changes of land level as to be almost entirely ruled out of account.

SYSTEMATIC MINERALOGY, BASED ON A NATURAL CLASSIFICATION. By THOMAS STERRY HUNT, M. A., LL. D. New York: Scientific Publishing Company. Pp. xvii+391, octavo. Price, $5.

THIS volume aspires to fill a unique place in the literature of mineralogy. As the author notes in his preface, there is no lack of treatises on the science, both determinative and descriptive. Still, to a naturalist familiar with the methods of nomenclature in the animal and vegetable kingdoms, the names of mineral species are barbarous, trivial, and unmeaning. This state of affairs

springs from the absence of a natural and rational system of classification, such as long since was introduced in the organic worlds. Not that attempts at this needed classification have been wanting. Two rival schools for many years have contended for methods diametrically opposed. The so-called natural-history or mineralogical method was advocated by Werner, Mohs, Jameson, Shepard, and Breithaupt; the chemical method, as formulated by Berzelius and developed by Rammelsberg, has been the basis of the text-books of Phillips, Dana, and Naumann. The possibility of reconciling these apparently antagonistic systems has been the aim of our author throughout his long career of study. Labors in this direction, which from time to time have been brought to the attention of the scientific world, are in the present volume connected and completed, forming what he terms a natural system of classification. He approaches his main task by a presentation of those elementary principles of chemistry and physics which underlie alike the two rival methods hitherto in the field. He discusses the nature of chemical combination, of which he holds that solution is a phase; the periodic law; and the important problem of ascertaining the relative degree of chemical condensation, upon which depends the varying hardness and insolubility of species. Between the physical characteristics and the chemical constitution of a mineral subsist necessary relations; on these rest the new classification, in which the seeming contradictions of the two rival schools are brought to accord. In place of the old trivial names we are given a classic Latin nomenclature for classes, orders, genera, and species — that for species being binomial. This system realizes, in a simplified form, that projected by Breithaupt and left unfinished by him. An examination of his nomenclature, as well as of those proposed by Mohs and by Dana, is followed by a synopsis of native species, with both their scientific and trivial names. This is succeeded by a critical discussion of the more important genera and species. In his two concluding chapters Dr. Hunt presents original and striking views of the genesis of carbonaceous minerals—graphite, diamond, petroleum, and coal; and, further, upon the mineral history of natural waters. In his preface our author announces his intention of preparing a descriptive mineralogy based upon this new classification.

SCHLIEMANN'S EXCAVATIONS: AN ARCHÆOLOGICAL AND HISTORICAL STUDY. By Dr. C. SCHUCHARDT. Translated from the German by EUGÉNIE SELLERS. New York: Macmillan & Co. Pp. 363, with Plates. Price, $4.

THE author of this book is Director of the Kestner Museum in Hanover. His purpose in writing it has been to present the results of Schliemann's Excavations in a concise form, which should make them more accessible to the general public; and the work appears to have been undertaken with the sanction of the discoverer. He has also sought, by careful discussion and comparisons, to find what are the ascertained results, and to present them free from the conjectures and enthusiastic speculations with which Schliemann's first reports, from the nature of the conditions under which they were written, are necessarily encumbered. The author was engaged in Grecian archæological excavation at Pergamos when he was intrusted with the preparation of the work. He improved the opportunity he then had of making personal observations on the spot, and of informing himself by intercourse with the persons concerned. The undertaking was a difficult one, for the questions which Dr. Schliemann's activity had called up are still undecided, and additions to our knowledge on the subject are constantly furnished by further excavations. But it was pleasant, for these objective studies in Greek antiquity have a charm that is surpassed in no other pursuit. In the account of Troy the history is given of the controversy of the two rival sites, the topography is compared with the references in the Iliad, and the reasons are given—all in seventy-five pages—for believing conclusively that Homer's Troy was real and Schliemann's identification of it is correct. Tiryns is described, in forty pages, as affording the most ancient illustrations of the civilization of which Mycenæ has furnished so numerous and so splendid examples. The largest space is given to Mycenæ, with its remarkable tomb-structures and treasure-chambers, and its truly astounding richness

in work of the goldsmith's art. A brief chapter on minor excavations includes accounts of the researches at Orchomenos and Ithaca. In a Historical Survey of the Heroic Age of Greece, the relations of Mycenæan civilization to that of Greece and Caria are discussed. Among the general conclusions to be drawn from Dr. Schliemann's Excavations are that they invariably confirm the former power and splendor of every city which is mentioned by Homer as conspicuous for its wealth or sovereignty; that the strongly fortified citadels, which do not appear after this (the Mycenæan period) either in Greece or Asia Minor, correspond exactly with those described by Homer; and that the wealth of metals in this "period of youthful display" is distinctly reflected in Homer. "But for the golden treasures of the shaft-graves, Homer's tales of chased goblets like the cup of Nestor, of bossed shoulder-belts, and the golden dogs that kept watch before Alkinoos's door, would still be treated as bold flights of fancy, as was, in fact, the case before the excavations." But the most striking and important correspondence between the Mycenæan discoveries and Homer is that shown in the inlaid work on certain dagger-blades found at Mycenæ. "Nowhere else in Greece has work of this sort, complete pictures in inlaid metals, been discovered. Yet Homer had a very clear conception of this kind of workmanship, for he describes in detail how, on Achilles's shield, vineyards were represented with purple grapes on golden stems, surrounded by a hedge of tin, and later on speaks of youths wearing golden swords hung from silver baldrics. It is enough to enumerate these leading points of agreement. They are sufficient proof that for certain parts of his descriptions Homer can have had no other models before him but those of Mycenæan art and civilization." The controversy still rages on the question whether there was a single personal Homer, author of the Iliad and the Odyssey, or whether the two books are collections of different sagas, sung by different minstrels, and composed in different ages. The author assumes the latter view, and speaks throughout the book as if it was a settled fact. He is sustained in this by Mr. Walter Leaf, an eminent English Homeric scholar, who furnishes a valuable critical introduction, in which the bearing of Dr. Schliemann's discoveries on this and other questions of Homeric interpretation are referred to rather than discussed, but who differs from the author on one or two points. In the appendices are given a report on the excavations at Troy in 1890, with the welcome announcement that Mrs. Schliemann will continue the work of her husband there; and an illustrated description of the two beautiful golden cups discovered in the tumulus at Vapheio—one of the most remarkable and interesting "finds" recorded as yet in the whole history of Greek archæological research.

THE SCIENTIFIC AMERICAN CYCLOPÆDIA OF RECEIPTS, NOTES, AND QUERIES. Edited by ALBERT A. HOPKINS. New York: Munn & Co. Pp. 675. Price, $5.

THIS compilation well illustrates the use of the accumulation of small things. For nearly fifty years the Scientific American has been publishing original contributions of facts, experiences, experiments, and practical observations in nearly every branch of the useful arts. The items have been printed in all departments of the journal, but especially in the columns of "Notes, Queries, and Correspondence," where their modest appearance furnished the careless reader no clew to their real worth, but whence the student seldom turned without having gained some prized acquisition to his knowledge. A considerable proportion of them embodied the fruits of special knowledge, which were made public nowhere else. In the files of the periodical they were as good as lost. Mr. Hopkins has made the vast compendium they afford the basis of his work. He has collected these, carefully digested and condensed them; has added to them the results of laborious researches among the difficult mysteries of Trade Secrets, and has incorporated with them, for the rounding off of his fabric, information from other cyclopædias of similar character. The arrangement of articles is alphabetical, according to their titles, with no other classification, the titles being given in full-faced type, with cross-references when they are needed. Illustrations are given, but not frequently. A few cautions are sounded in the preface to those

who are to use the receipts, concerning the need of care to obtain the right materials and pure materials, to follow the directions precisely, and observe all precautions in detail. Tables of weights and measures and chemical synonyms are given in the appendix.

In the *Land of the Lingering Snow* (Houghton, Mifflin & Co., $1.25) a winter outdoor book is given us by Mr. *Frank Bolles*, of Cambridge, Mass. In twenty-six essays the "Stroller in New England," as the author styles himself, chronicles his weekly visit to points of interest within not too hard reach of his home, from January to June. They were made, in fact, twice a week, for he took both Saturday and Sunday for his excursions. In them he enjoyed the weather, whatever it might be, the exultation of facing the fiercest storms if they came, the scenery, and the birds. No stress of weather seems to have deterred him from taking his short railroad trip and long walks, or to have overcome the enterprise of the birds, which he never failed to find in numbers. On the first Sunday of the year, in the deep snow, he finds traces of a crow, fifteen quail, and a robin; the next week, when everything is covered with ice, twenty chickadees, crows, robins, and a hawk; on the third walk, in a tempest, eighty-five birds, representing nine species. They seem to have been the objects for which he was looking, and he found them. As the spring comes on and advances into summer the pictures gain in freshness and warmth, but the author's mood is always the same. It is that of the lover of Nature who sees beauty and life in all their aspects and knows how to paint them.

The point of view taken by Mrs. *Ellen M. Mitchell*, in her *Study of Greek Philosophy* (S. C. Griggs & Co., Chicago, $1.25), is indicated by her dedication of it to the Kant Club of Denver, and her acknowledgment of indebtedness to the Concord School of Philosophy, Dr. W. T. Harris, and the histories of Zeller and Hegel. The book grew out of the studies of the author in connection with a woman's club in St. Louis, and afterward in Denver. Her verbal expositions gradually assumed written forms, and eventually came into their present shape; and the whole bears the impress of the thoughts of the other members of the clubs as well as of the author's own. Beginning with the assertion of the identity of philosophy and the history of philosophy, the author analyzes the character of the Greek philosophy, and then considers it from the beginning, in the pre-sophistic philosophy, through all its stages of development, and as expounded by the larger host of teachers whose names have become identified with much of the best of human thought, and whose influence has endured and is still strong. An introduction is furnished by William R. Alger, who glorifies philosophy as the supreme department, the most important and most attractive branch of knowledge, setting it above literature and science.

In *Ben Beor, a Story of the Anti-Messiah* (Baltimore, Isaac Friedenwald & Co.; Vicksburg, Miss., the author), the supernatural and the allegorical are mingled. The aim of the author, *H. M. Bien*, a rabbi of Vicksburg, Miss., has been to exhibit the agencies which are assumed to have been working during past ages to suppress the rights and liberties of the people; "upholding serfdom and superstition for the benefit of a few privileged classes." The persecutors and haters of man are called as a unit the Anti-Messiah, whose story is set forth under the name of Ben Beor. This character, called after the biblical Balaam Ben Beorz, who is endowed with an immortality like that of the Wandering Jew, appears in the ancient world as the instigator of the great evils which afflicted its nations; as the concocter and distributer of strong liquors and the stimulator of evil passions; as the chief agent in provoking the siege and destruction of Jerusalem, the Roman persecution of the Christians, the suppression of knowledge and free thought which marked the dark ages, the promoter of priestcraft and the Inquisition, and the upholder of despotism down to modern times. The invention of printing and the Reformation were antagonistic to his plans, and his power and his office ceased with the promulgation of the Declaration of Independence.

The fourth volume of Prof. *J. C. Branner's Annual Report of the Geological Survey of Arkansas for 1888* contains the geology of Washington County and the Plant List for the State. While it has been the plan of the survey to study and report upon geologic topics rather than upon geographic

areas, an exception has been made in the case of Washington County, because its geology embraces a complete section at the westernmost exposure in the State, across the lower carboniferous rocks from the base of the coal measure to the Silurian; and because the location of the State University at Fayetteville makes it desirable for the geology of the surrounding region to be worked up in detail for purposes of instruction. The economic results of the survey are not of great positive value, and Washington County will have to depend upon its other advantages, which are many and excellent, for its growth and prosperity. The report, which was prepared by Prof. F. W. Simons, is accompanied by a geological map. The Plant List is chiefly the work of Prof. F. V. Coville, with additional contributions by Prof. Branner, who remarks upon the clear distinction between the flora of the limestone and of the sandstone formations, as showing to how large an extent the distribution of plants is governed by the character of the soil.

The fourth part of Mr. *Harold Whiting's Course of Experiments in Physical Measurement* (D. C. Heath & Co.) consists of Appendices and Examples for the use of teachers. In the first appendix are described the laboratory, or room where the experiments are to be performed, which should be well lighted and uniformly heated, and should have good ventilation. The use of iron in construction should be avoided, on account of its magnetic influence, and special precaution should be taken to avoid vibrations. A basement is not suitable, or an attic. Such a room as is commonly used for lecture purposes is the most suitable—a two or three story room reaching from the first floor to the attic, and lighted on three sides, is the best. The arrangement of the tables, benches, and apparatus is considered, and the apparatus is described in detail, beginning with the most needed articles. In the third appendix, expenses, the most economical methods in dividing the classes and delivering the lectures, so as to get along with the fewest sets of apparatus and the smallest number of teachers practicable, are considered; and in the fourth appendix, the best methods of making the instruction given efficient and of permanent value. The rest of the volume is devoted to models of experiment, demonstrations of rules etc. First are examples of observations and calculations in a hundred experiments, illustrating the details to be regarded in each of the numbers and the manner of treating; there are three lists of experiments, intended to cover the ground required for admission to Harvard College, in both elementary and advanced physics. These are followed by discussion of the principles of finding the average values of variable quantities, the probability of errors, "proofs," and "useful formulæ," with, in conclusion, a full index to the whole series of books.

The Rev. *J. C. Atkinson*, Canon of York, publishes through Macmillan & Co., a collection of stories in the style of Jack the Giant Killer, and Jack and the Bean Stalk, entitled *The Last of the Giant Killers, or the Exploits of Sir Jack of Danby Dale.* They were written without any intention of publication, for the amusement of certain children belonging to different families, who were more or less interested in the district of which Danby Dale is a part. In nearly every instance the stories are based upon or connected with some local legend, local fact, or local habitation; and the relations are prefixed by a few remarks on the popular disposition to attach a superstitious significance to peculiar features in the landscape and to curious local incidents.

W. S. Gottsberger & Co. add a humorous book to their series of usually sober or classical romances in the shape of *A Little Tour in Ireland*, in which a visit to Dublin, Galway, Connemara, Athlone, Limerick, Killarney, Glengarrif, Cork, etc., is described by *An Oxonian*, with a vein of jollity pervading the story and a disposition to look upon the laughable side of everything—which are much heightened by Mr. John Leech's illustrations. The book is one from which the careful reader, by straining the substance from the froth, may get a fair and pleasing view of the country and its sights.

A collection of short stories by Count *Leo Tolstoi*, published by C. L. Webster & Co., includes *Ivan the Fool*, or the Old Devil and Three Small Devils, *A Lost Opportunity*, and *Polikushka*. The translation is direct from the Russian by Count Norraikov, who thinks that justice is not done to the author

in translations through the French or in direct translations by persons who know Russian only imperfectly. The first of the stories, Ivan the Fool, portrays Tolstoi's communistic ideas and the ideal kingdom he would establish in which each and every person should be a worker and a producer. A Lost Opportunity pictures Russian peasant life, with many of its peculiar customs. Polikushka describes the life led by a servant in a nobleman's court household, and marks the difference in the conditions and surroundings of such servants from those of ordinary peasants.

An exhibition of ten years' progress of the "New Learning" is made in Prof. *A. F. Chamberlain's* pamphlet on *Modern Languages and Classics in America and Europe* since 1880. It presents the views of numerous teachers and persons interested in education concerning the success with which the scheme for giving more relative attention to the modern languages has met in the United States, Great Britain, France, Italy, Hungary, Germany, and Norway and Sweden. Published at the office of The Week, Toronto.

Mr. *Henry George's* Open Letter to Pope Leo XIII on *The Condition of Labor* is a respectful, temperate reply to those parts of his Holiness's Labor Encyclical which bear on the doctrines held by the school of publicists of which the author is the most conspicuous representative. It is of value and interest to us chiefly because it presents a clear, succinct, and precise statement of what the doctrines of that school are, what they are seeking, and of the manner in which they purpose to promote their objects by peaceful agitation.

In a manual on *The Sextant and other Reflecting Mathematical Instruments* (D. Van Nostrand Company, 50 cents), Mr. *F. R. Brainard*, of the United States Navy, presents a compilation from various sources on the instruments concerned, and adds a few ideas and suggestions of his own, and of officers who have been associated with him; embodying also practical hints on the errors, adjustments, and use of the instruments.

In a manual of the handy Van Nostrand Science Series, *How to become an Engineer*, the theoretical and practical training necessary in fitting for the duties of a civil engineer are set forth by Prof. *George W. Plympton*, who supplements his views by quotations from the opinions of eminent authorities and full lists of the courses of study in the technical schools—including the Rensselaer Polytechnic Institute as an example of American schools, and several schools of England and the European continent. Price, 50 cents.

Light, an Elementary Treatise (Macmillan & Co., 75 cents), has been prepared by Sir *Henry Trueman Wood* with a view of providing such information as an intelligent student unfamiliar with natural science would require. In it are given an explanation of the modern theory of light and of the phenomena which are matters of common observation; descriptions of the nature of color and the manner of its production; accounts of the more important optical instruments and the principles of their action; an exposition of the chemical effects of light and their application in photography; and descriptions of the phenomena produced by polarized light and by fluorescence. The book is one of the numbers of Whittaker's Library of Popular Science.

Information about electric lighting, practical and theoretical, is given in the *Practical Treatise on the Incandescent Lamp*, prepared by *J. E. Randall*, Electrician of the Thomson-Houston Company, and published by the Bubier Publishing Company, Lynn, Massachusetts. It contains, in brief, the history of incandescent lighting, the philosophy and construction, with details, of the incandescent lamp, and observations on photometers and their use. The author estimates that 25,000 incandescent lights are made in the United States daily, or 7,500,000 a year, and he believes that the "life" of the lamp is more likely to be abbreviated than increased in the future, because consumers will grow more particular about the quality of their light, and will change their burners when they cease to be efficient instead of using them till they burn out.

Prof. *Wesley Mills*, believing that a dog is a useful member of the household and especially valuable in the city as a companion and means of instruction for the children, and recognizing the embarrassment city families labor under through not knowing how to manage with the animal in their narrow

quarters, has prepared a little book on *How to keep a Dog in the City*, which is published by William R. Jenkins, New York, for 25 cents. It supplies information respecting the details of the management of the dog from puppyhood up, including lodging, feeding, measures for cleanliness, care of his skin, exercise, training, and treatment of his ailments.

How to make a Trial Balance representing any number of accounts in less time than an hour is explained in a small book written and published at Baltimore, by A. Weinberg. The method is the result of much thought and study, and may, the author claims, be applied to a business of five thousand accounts as easily as to one of fifty accounts, with great saving of time and labor.

Two series of twelve charts each, published by the United States Signal Office, show graphically the probability of rainy days and the average cloudiness for each month in all the regions of the United States within the circle of observations of the several local signal stations. They are based on observations made from 1871 to 1888 inclusive, or for shorter periods at the more recently established stations. The percentages of rainy days (called such when precipitation to the extent of ·01 inch or more occurs) are calculated for each station and month from the average number of such days. The cloudiness charts are made up from eye-observations taken three times a day. They are expected also to show the sunshine by taking as sunshine the complement of the cloudiness. Such data, when well matured, are of great value in the study of climate and its adaptability to different conditions and needs of health.

Three numbers of *The Quarterly Register of Current History* (Evening News Association, Detroit) have been published. The first number, February, 1891, contained a review of the history of the world during 1890. The second number, May, and the third, August, 1891, are devoted respectively to the history of the first and second quarters of the year. The matter is classified and arranged under the heads of International Affairs; Affairs in Europe, in Asia, in Africa, and in America; Record of Progress, and Necrology. The idea of the publication is an excellent one. The short view we have been able to take of the numbers does not suggest that anything of value is omitted, but shows several things of minor importance which, if they had been left out, would not be missed a year or two hence; and there is room for improvement in pruning and smoothing the articles, the present style of which is more like that of a daily paper than of a record made to last.

To the attempts to teach foreign languages in the way they are learned in Nature must be added the method of Dr. *Edward Pick*, in which the language itself is employed as the instrument, and is taught by comparison with the English before the grammar is learned. The author holds that remembrance is assisted most efficaciously in the study if we take the known as the starting-point of comparison with the unknown. In the study of foreign languages the known consists of those elements which we find in our own language, or in any other language familiar to us. Thus the knowledge of one foreign language facilitates the study of others. The usual method of studying foreign languages—beginning with grammar—"is contrary to the nature of the mind, because we begin with the unknown—nay, more, we begin with details unknown to us (the grammatical rules) of a thing equally unknown (the language)." In *Dr. Pick's Method applied to acquiring the French Language* (C. W. Bardeen, Syracuse, New York), the pupil is introduced to Voltaire's History of Charles XII, for the study of the French text, word for word and form for form, with the English translation.

PUBLICATIONS RECEIVED.

Ashley, J. M. The Impending Political Epoch. New York: Evening Post. Pp. 87. 25 cents.

Ball, Robert. Star Land. London and New York: Cassell & Co. Pp. 876. Illustrated.

Ball, Robert. The Cause of an Ice Age. New York: D. Appleton & Co. Pp. 180. $1. Illustrated.

Bennett, T. J. Texas Sanitarian. Austin: Texas Sanitarian Publishing Co. Monthly. Pp. 72. $2 a year.

Bronson, T. B. Colloquial German. New York: Henry Holt & Co. Pp. 147. 65 cents.

Call, R. E. Tertiary Silicified Woods of Eastern Arkansas. Pp. 9. Reprint.

Cannizzaro, S., and Fabris, G. Tests for the Purity of Olive Oil. Boston: J. A. Hayes & Co. Pp. 41.

Carpenter, W. B. The Microscope. Seventh edition. Edited by W. H. Dallinger. Philadelphia: P. Blakiston, Son & Co. Pp. 1099. Illustrated.

Charts showing the Isobars, Isotherms, and Winds

in the United States for each Month from January, 1871, to December, 1873. War Department.

Cherrie, G. K. Notes on Costa Rican Birds. Smithsonian Institution. Pp. 20.

Columbia Daily Calendar for 1892. Boston: Pope Manufacturing Co.

Cowles, Edward. Neurasthenia and its Mental Symptoms. Pp. 105. Reprint.

Cragin, T. W. New Observations on the Genus Trinacromerum, pp. 4; and On a Leaf-bearing Terrane in the Loup Fork, pp. 4. Reprints.

Crummell, Alexander. Africa and America. Springfield, Mass.: Wiley & Co. Pp. 466.

Drake, S. A. The Battle of Gettysburg. Boston: Lee & Shepard. Pp. 178. 50 cents.

Dufferin, Lady. My Canadian Journal. New York: D. Appleton & Co. Pp. 456. $2. Illustrated.

Findlay, G. Working and Management of an English Railway. Macmillan & Co. Pp. 354. $1.50.

Fiske, S. Holiday Stories. Boston: Benjamin R. Tucker. Pp. 208.

Flogel, E. Carlyle's Moral and Religious Development. New York: M. L. Holbrook & Co. Pp. 140. $1.

Foote, A. E. New Locality for Meteoric Iron: Discovery of Diamonds in the Iron. Pp. 5. Reprint.

France, Anatole. Thais. Chicago: N. C. Smith Publishing Co. Pp. 205.

Furney, E. E. Culture: A Modern Method. New York: L. H. Brown & Co. Pp. 322.

Gilbert, C. H. Apodal Fishes from the Tropical Pacific. Smithsonian Institution. Pp. 6.

Gill, T. On the Genus Labrichthys, etc. Smithsonian Institution. Pp. 9.

Hall and Bergen. A Text-book of Physics. New York: Henry Holt & Co. Pp. 338. $1.25.

Halstead, B. D. Fungi injurious to Fruits and to Garden Crops. Columbus, O.: Westbote & Co. Pp. 13.

Harper and Burgess. An Inductive Latin Primer. New York: American Book Company. Pp. 424. $1.

Hopkins, A. A. The Scientific American Cyclopædia of Receipts, Notes, Queries. New York: Munn & Co. Pp. 675. $5.

Jones, Alonzo T. The Two Republics of Rome and the United States of America. Battle Creek, Mich.: Review and Herald Publishing Co. Pp. 895. Illustrated.

Kirkpatrick, T. J. The Modern Cook-Book. Springfield, O.: Mast, Crowell & Kirkpatrick. Pp. 320.

Lewis, T. H. Effigy Mounds of Buffalo Lake, Wisconsin. Pp. 3. Reprint.

Loewy, Benjamin. A Graduated Course of Natural Science. Part II. New York: Macmillan & Co. Pp. 257. 60 cents. Illustrated.

Lyons, Daniel. Christianity or Infallibility. New York: Longmans, Green & Co. Pp. 234. $1.50.

McCalley, H., and Gibson, A. M. Report on the Coal Measures of the Plateau Regions of Alabama. Pp. 238, with Maps.

Macfarlane, R. Notes on Birds and Eggs collected in Arctic America. Smithsonian Institution. Pp. 34.

Marble, A. P. Sanitary Conditions for Schoolhouses. Washington: Bureau of Education. Pp. 121, with 45 Plates.

Mason, W. P. Notes on Cases of Drinking-water and Disease. Pp. 10. Reprint.

Massee, George. The Plant World. New York: Macmillan & Co. Pp. 212. $1. Illustrated.

Maycock, W. P. First Book of Electricity and Magnetism. New York: Macmillan & Co. Pp. 133. 60 cents.

Nuttall's Ornithology. Edited by Montague Chamberlain. 2 vols. Boston: Little, Brown & Co. Pp. 473 and 431. $3. Illustrated.

Ochorowicz, J. Mental Suggestion. New York: Humboldt Publishing Co. Pp. 369. $2.

Ostwald, W. Solutions. New York: Longmans, Green & Co. Pp. 316. $3.

Paquin, P. The Supreme Passions of Man. Battle Creek, Mich.: Little Blue Book Co. Pp. 150.

Paquin, P. The Bacteriological World. Monthly. Pp. 40. $2 a year.

Parker, William W. The Ancient and Modern Physician. Lynchburg: Virginia Medical Society. Pp. 18.

Peters, E. D. Copper-smelting. Second edition. New York: Scientific Publishing Co. Pp. 398. Illustrated.

Physician's Visiting List for 1892. Philadelphia: P. Blakiston, Son & Co.

Poole, Joseph. Practical Telephone Hand-book. New York: Macmillan & Co. Pp. 288. 75 cents. Illustrated.

Poole, W. H., and Mrs. Cooking for the Diabetic. New York: Longmans, Green & Co. Pp. 64. $1.

Pringle, Allen. Bibles and Religions out of the Public Schools. Canadian Secular Union. Pp. 24.

Remondino, P. C. History of Circumcision. Philadelphia: F. A. Davis. Pp. 346. 50 cents.—An Instructive Case of Uræmia. Pp. 8. Reprint.

Report of the Commissioner of Pensions for the Year ending June 30, 1891. Pp. 84.

Report of the New York State Board of Charities for 1890. Pp. 349.

Shaler, N. S. The Story of our Continent. Boston: Ginn & Co. Pp. 290. 85 cents.

Shaw, G. B. The Quintessence of Ibsenism. Boston: Benjamin R. Tucker. Pp. 170. 25 cents.

Sloane, T. O'Conor. Electricity Simplified. New York: N. W. Henley & Co. Pp. 158. $1. Illustrated.

Smith, J. B. Noctuidæ of Temperate North America. Smithsonian Institution. Pp. 80.

Smith, Oberlin. The Engineer as a Scholar and a Gentleman. Pp. 14. Reprint.

Stejneger, L. On the Snakes of the Genus Lichanpurs. Pp. 5.—Description of a New Species of Chameleon. Pp. 2.

Stevenson, J. J. The Chemung and Catskill [Upper Devonian] on the Eastern Side of the Appalachian Basin. Pp. 31. Reprint.

Torrey, Bates. Practical Type-writing. New York: Fowler & Wells. Pp. 156.

Upham, W. Geographic Limits of Species of Plants in the Basin of the Red River of the North. Pp. 32. Reprint.

Watts, C. A. The Agnostic Annual. London: W. Stewart & Co. Pp. 68. 6*d*.

Whitney, W. D. Introductory French Reader. New York: H. Holt & Co. Pp. 256. 70 cents.

Yeaman, G. H. The Silver Question. Pp. 27.

POPULAR MISCELLANY.

Ancient River Channels.—A remarkable contrast in the physical geography of the eastern and western coasts of the American continent is pointed out by Prof. Joseph Le Conte. The continent is bordered on both sides by a submarine plateau sloping gently seaward till it attains a depth of about one hundred fathoms, from which point the bottom drops off rapidly into deep water. This submarine plateau may be regarded as a sub-

merged coastal plain, and its margin as the true boundary between the continent and the ocean basin, or as the submerged continental margin. On the eastern coast the submarine plateau is trenched with submarine troughs running out from the mouths of the great rivers to the submerged continental margin and then opening into deep water. The best known of the channels are opposite the mouths of the Hudson and Delaware Rivers, Chesapeake Bay, and the Mississippi. Along the California coast the phenomena are different. The researches of Prof. Davidson have brought to light some twenty or more submarine channels on the coast from Cape Mendocino to San Diego, a distance of about seven hundred miles. But they have no obvious relation to existing rivers. They are not a submarine continuation of any system of river valleys on the adjacent land, but run in close to shore and abut against a bold coast, with mountains rising in some cases to three thousand feet within from three to five miles of the shore line, and wholly unbroken by any large river valleys. The channels of the Eastern coast are accounted for by supposing that they were always connected with the rivers opposite them, and that they have assumed their present positions by the operation of the changes of level to which the land has been subjected. But the disconnected positions of the Western channels can not be accounted for except as being the result of orogenic changes which have diverted the lower courses and places of emptying of the rivers since the channels were made. Prof. Le Conte's paper is devoted to the study of the nature and history of these changes.

Jupiter and the Comets.—Prof. H. A. Newton showed, at the meeting of the British Association, that if a comet or other small body should pass in front of Jupiter, the kinetic energy of the planet would be increased by the gravitational attraction between the two bodies, while that of the comet would be diminished, and might be diminished to such an extent as to cause it to form (though possibly only temporarily) a member of the solar system. On the other hand, if a comet, already a member of the solar system, pass behind Jupiter, the kinetic energy of the planet will be diminished and that of the comet will be increased, and may conceivably be increased under favorable circumstances to such an extent that the comet may no longer remain a member of the system. The author had calculated that of one billion comets from space crossing, in all directions, a sphere equal in diameter to that of Jupiter's orbit, about twelve hundred would come near enough to Jupiter to have their period so much diminished as to be less than that of the planet.

The Baths of the Accursed.—Hammam Meskoutine, or the Baths of the Accursed, are a famous bathing-place and health resort not far from Constantine in Algeria. They are but a few minutes' walk from the railway station. The first object of interest within a quarter of a mile of the station is a superb hot waterfall, whence the vapors fly away abundantly. "Yet," says a writer who describes it, "it is not all of water. For the most part it is rigid, like a thing of ice. It is, in fact, mainly a petrifaction. The calcareous deposit in the hot spring above has incrusted the rocks, so that they have the corrugated appearance and something of the color of barley sugar. Here and there, over and between the still masses, there is an ooze or trickle of warm water, adding to the work already done. Grass and flowers grow well by the sides of this nutritious waterfall, though the whitened soil in the neighborhood does not seem adapted for vegetation of any kind. You climb to the level of the cascade, and then see, close by, a number of odd-looking cones and columns standing up from the blanched surface of the ground. The soil is hot to the hand, and you tread with an echo." The springs bubble up with a temperature of more than 200° Fahr. A litter of egg-shells and fowls' feathers by the edge of them tells of the purpose they serve to the residents of Meskoutine. Here the dinner is cooked, and the clothes are washed in one or another of the little basins by which the springs eddy up to the daylight. Though the Arabs give the baths an impolite name, and tell various weird tales about them, they love them well. The cones look like a procession of gigantic phantoms suddenly petrified. Some are six or seven feet in height, and some are fourteen or fifteen feet. They mark the sites of

ancient springs now subsided. At one time each of these cones was but the mere rim or lip of a basin in which the hot water bubbled as we see it at the top of the cascade. Thus the water continued to boil upward in jets, like the geysers, for centuries, gradually, by the deposit of lime which fell from it, raising its lip. At length the subterranean force that impelled it vertically weakened. The cone had attained its full stature. According to the Arabs, however, the cones are deaf, dumb, and blind genii in whose charge Solomon put the baths when he is supposed to have created them for all the world. The worthy guardians, who still think King Solomon is alive, continue to keep the baths warm as they did at the first for the use of the king's subjects. It is supposed to be a matter of great difficulty to announce to these genii the fact that their master is dead. The inference is, therefore, that they will continue to warm the baths to the end of time. Various other stories are told to account for the origin of the baths.

Lepers in the Middle Ages.—Leprosy was common in England and continental Europe some five hundred years ago, and those who were afflicted with it were subjected to treatment which would now be considered cruel. Institutions for the segregation and treatment of the diseased, erected by the Church or by the aid of pious donors, were to be found over all England; and at one time there was a leper hospital or village near every town. According to Prof. Simpson, there were in the year 1226 two thousand lazar-houses in the small kingdom of France. "In the thirteenth and fourteenth centuries," says an English writer, "a leper was not allowed to hold property, was deemed incapable of making a will, and lost all the privileges of citizenship. He was hunted from the towns and driven from the dwellings of men; he was forbidden to drink from the running stream, lest he should defile it, and it was unlawful for him to touch things that were used for food by man. Anything was deemed good enough for the leper." When a man was supposed to have leprosy, he was examined, and, if the disease was found upon him, was banished from society, after enduring a service at the church resembling the funeral ritual, and sometimes embodying a part of it. If a man was wealthy, he might buy himself an exemption from the extreme disabilities, as did the abbot Richard de Wallingford, who was able, with great difficulty, to keep his position. The hospitals maintained by the Church did much to alleviate the woes of lepers. The regulations of the Hospital of St. Julian, which were drawn up in 1344, have been preserved. Though strict, they were not hard. Among them was an exhortation to avoid slander and cultivate brotherly love and true charity. Each leper was allowed seven loaves of bread a week, five of white and two of brown, made from corn "just as it had been thrashed from the sheaf." Every seventh month he had fourteen gallons of ale or eight pence; on Christmas-day, forty gallons of ale or forty pence, two quarters of pure and fine corn, and his share of fourteen shillings, to be applied to the purchase of mufflers. On St. Martin's day each one had a pig from the common herd, the patients taking choice in the order of seniority of admission, or a money equivalent in case pigs were scarce. Other periodical allowances were a bushel of beans or peas every winter; a quarter of oats on the 14th of February; two bushels of salt, and four shillings for clothing, on the 24th of June; a penny on St. Alban's, St. Julian's, and Easter days; a half-penny on Ascension-day "for the taking away from themselves of dirt"; and flour for pancakes on Shrove Tuesday. With these gifts they were commanded to be content.

Offices of Forests.—A writer who narrates the history of the woods and pastures of Lynn, Mass., in the Transcript of that city, says that the "Lynn woods have had three periods of usefulness. Down to 1706 they furnished pasturage and timber and shelter to the village. In their second period, covering the life of the town in its shifting from the pastoral to mechanical pursuits, they were still useful, although restricted to furnishing fuel to the inhabitants. As time went on, and cheap coal came in with the ever-advancing density of population, it seemed as if the slaughtering brick-maker and fire-fiend would render the woods a desert and a menace to our fair town." But a period of greater usefulness, according to Garden and Forest, has come. The inhab-

itants of cities require pure water, and the people of Lynn have wisely determined to protect and preserve the abundant supply which still flows from the springs that watered the cattle of the Puritans, and these woods now perform their noblest duty, in furnishing the great city with water, oxygen, and sylvan beauty for the repose of its inhabitants.

Fossil Insects.—The publications of the last ten years on fossil insects comprise, according to Mr. S. H. Scudder's review, about one third of a complete catalogue of papers on the subject. This literature records some of the most important discoveries that have been made in this field. Passing the discovery of Silurian scorpions in several parts of the world, we have, first, Brongniart's discovery of the hexapod, *Palæoblattina*, in the Silurian of France, as yet the only known true insect in that system. Next is the remarkable Devonian insect fauna in New Brunswick, first announced before 1880, but only fully published, with figures of the species, then. With these must be classed the Devonian myriapods, the earliest known members of that group, elaborated by Peach. In the Carboniferous period we have the abundant forms of Mazon Creek and other deposits in the United States, which include so extraordinary a number of blattarians that Mr. Scudder calls it, so far as its insect fauna is concerned, "the age of cockroaches." These discoveries are even more than paralleled by the similar discoveries of M. Brongniart in France, equally characterized by multitudes of cockroaches. There the principal discoveries in the Palæozoic series have been accompanied by the publication of many striking forms which indicate the ancestral types of living insects, or by the better elucidation of types already known but whose significance had not been understood. A new era has been begun in the study of the earlier types, in that the subjects have been treated in more than a scattered way, by fuller discussions, and by attempts to systematize. Our knowledge of Mesozoic insects has been likewise much enlarged. Of Tertiary insects, the earliest are to all general intents and purposes identical with those of to-day, although they differ no doubt specifically, and to a considerable degree generically. Most of those so far recovered from temperate regions indicate a warmer climate in their time; but, taken as a whole, the grand features of insect life appear to have been essentially the same since the beginning of Tertiary times. Of the insects of this period, the Florissant deposit alone of the Western United States is as productive, if we exclude the insects found in amber, as all the Tertiary fields of Europe taken together. Last year the author found that the strata of a considerable tract of country in western Colorado and eastern Utah were packed with fossil insects as closely as at Florissant. "Whether these new localities will excel or even equal that place in the variety of their fossil treasures is yet to be determined; but there can hardly be any doubt that we shall soon be able in our Western Territories to rehabilitate successive faunas as successfully as has been done with many of our vertebrate types, and as has not yet been done for insects in any country in the world." Insects have now been found, too, in a score of places in our Carboniferous series.

Ancient Superstitions in Italy.—In a paper at the International Folk-lore Congress on Modern Tuscan Tradition, Mr. Charles G. Leland spoke of a mountainous district, the Romagna Tuscana, between Forli and Ravenna, in which the peasantry have preserved old customs and traditionary lore to a degree for which there was no parallel elsewhere in Europe. There are certain families in which witchcraft is especially cultivated, among whom the old traditions and names of the gods still live. There is ten times as much belief in the superstitions as in the Catholic religion; and when people are in trouble, though they first tried the saints, they always found sorcery and spirits best in the end. The basis of the cult was a peculiar polytheism, or a worship of the spirits called *folletti*. These spirits generally bear the names of old Etruscan gods, mostly very little changed, or of the old Roman minor rural deities. First among them is Tinia, the *folletto* of thunder, lightning, and storms. There is also an herb called *tigna*, identified with this spirit and much used in magic to repel Tinia when he injures crops. The spirit of

the vineyards, wine-cellars, and wines, whose name, Fafian, is but little changed from Fufluns, the ancient Etruscan Bacchus, is described as "enchantingly beautiful" and given to good-natured mischief. When the peasants are gathering grapes, he comes invisibly and knocks their panniers all about; but if this is taken pleasantly, he replaces everything, and then his ringing laughter is heard. Sometimes he falls in love, and, of course, always woos successfully. Teramo is the spirit of merchants, thieves, messengers, and carrier-pigeons, and corresponds with Turnus, the old Etruscan Mercury. Maso or Mas is Mars, not the god of war, but his Etruscan prototype, a god of crops and fertility. Diana preserves to this day her title of queen of the witches. The great mediæval writers declare that all the Italian witches asserted that they did not worship Satan, but Diana and Herodia. Marcellus of Bordeaux, who was court physician to the Emperor Honorius in the fourth century, collected and recorded a hundred magical cures which he had gathered among old women and peasants. Of these, Mr. Leland by dint of much inquiry had found fifty in practical use, and had recovered some of them in a more perfect form than that given by Marcellus. Through all this lore there runs the thread that all disorders and ill luck and earthly mischances are caused by witchcraft, and must be cured by Christian saints or heathen sorcerers, of which the latter are preferred.

Allotropism in Alloys.—In his presidential address before the Chemical Section of the British Association, Prof. Roberts Austen spoke of the consequences of allotropic changes which result in alteration of structure as being very great. The case of the tin regimental buttons which fell into a shapeless heap when exposed to the rigorous winter of St. Petersburg is well known. The recent remarkable discovery by Hopkinson, of the changes in the density of nickel-steel (containing twenty-two per cent of nickel) which are produced by cooling to 30°, affords another instance. This variety of steel, after being frozen, is readily magnetizable, although it was not so before; its density, moreover, is permanently reduced by no less than two per cent by the exposure to cold; and it is startling to contemplate the effect which would be produced by a visit to the arctic regions of a ship of war built in a temperate climate of ordinary steel, and clad with some three thousand tons of such nickel-steel armor; the shearing which would result from the expansion of the armor by exposure to cold would destroy the ship. The molecular behavior of alloys is, indeed, most interesting. W. Spring has shown, in a long series of investigations, that alloys may be formed at the ordinary temperature, provided that minute particles of the constituent elements are submitted to great pressure. W. Hallock has recently given strong evidence in favor of the view that an alloy can be produced from its constituent metals with but slight pressure, if the temperature to which the mass is submitted be above the melting-point of the alloy, even though it be far below the melting-point of the more easily fusible constituent. A further instance is thus afforded of the fact that a variation of either temperature or pressure will effect the union of solids.

The Instincts of Cattle.—Many habits of the lower animals can be explained by analogy with our own behavior in similar circumstances and still more with that of savage men. Thus the tenderness and ingenuity that a cow shows in caring for her calf, and the fierce courage that she displays in its defense against foes from which she would flee if alone, all find their counterparts in human life. Several instincts that are more difficult to account for are discussed by Mr. W. H. Hudson, in a recent number of Longman's Magazine. This writer accounts for the angry excitement shown by cattle on the appearance of a red cloth as an outgrowth of curiosity. Were a red flag displayed in a field by itself, the animals would surround it with every sign of interest and curiosity; but should a man drape himself in it, the bolder would attack him, not on account of the color, but because the man had drawn their attention irresistibly to himself. In regard to the unerring detection by cattle of the spot where blood has been spilled, the furious fighting over it by the stronger males, the strange anxiety of the whole herd to survey it, and above all the weird horror expressed in the discordant

note that the bellowing at once assumes, Mr. Hudson supposes that "their inherited memory associates the smell of blood with the presence among them of some powerful enemy," and that their attacks on each other result from the lack of any visible foe. This seems reasonable, and it might be worth while for Mr. Hudson to consider whether a better explanation of the excitement caused by red objects could not be found by connecting the impression produced by the sight of red—the color of blood—with that produced by the smell of blood. To the same blind terror and the same invisibility of cause is attributed the impulse of cattle to gore or trample to death a disabled companion—ability to discriminate between distress and the cause of distress being wanting. Of a very different origin is the persecution of the weakly members of a herd by the stronger. This comes from the instinct of self-preservation that prompts the individual animal to establish ascendency over as many of the herd as it can.

The Preparatory Stage in Education.—The young mind, with all its latent powers, with all its individual characteristics, is likened by President J. M. Coulter to an uncultivated field that must be drained and broken up and harrowed, to be ready for the seed; and the seed is one's specialty, which is to be planted when the ground is ready. This popular cry for a "practical education" asks us to omit the preparation of the soil and plant the seed at once, that there may be no loss of time. This figure seems to express the proper relationship between the general training or preparation which we call "education" and the special training or apprenticeship which looks directly to one's life-work. It is these two stages which are distinct in method and purpose that are ignored in the popular reasoning. One prepares the soil, the other sows the seed; the one reduces the metal, the other fashions it to its special use; the one develops the muscle, the other turns this developed power to some definite purpose; the one weaves the cloth, the other cuts and fits it. Think of shaping an axe from unreduced ore; of wielding a sledge-hammer with weak and flabby muscles; of cutting clothes from an unworked fleece, and you have the sort of reasoning used by "practical" men concerning what is called "practical" education. The author thinks it is apparent that mental muscle may be developed without a single item of information being obtained as such; and that it may often be cultivated in a pleasanter, more even, and scientific way, if the utilitarian idea of obtaining information be not constantly present. Education, then, being the development of mental muscle, the period of preparation, we are confronted with the question, "What is a practical education?" not in the popular meaning of the term, but really. Plainly, it is that kind of education which will bring about the development of this mental muscle, this preparation which is to bring ability to grasp one's specialty and the problems of life. Hence, studies become tools, the agricultural implements, not the seed; the means, not the end. No study in our ordinary, unprofessional schools has any right to be other than a means; the subject itself entirely lost sight of in its application; the grindstone forgotten in the sharpening of the tool.

The Uses of Potlatch.—The Northwestern Indian custom of potlatch, from Dr. Boaz's description of which in a report to the British Association we gave a condensed extract in the May number of the Monthly, is regarded by the Hon. Horatio Hale as something essentially different from the parade of wasteful and ostentatious profusion which it superficially appears to be. It is, he says, "a method most ingeniously devised for displaying merit, acquiring influence, and at the same time laying up a provision for the future. Among these Indians, as among all communities in which genuine civilization has made some progress, the qualities most highly esteemed in a citizen are thrift, forethought, and liberality. The thrift is exhibited by the collection of the property which is distributed at the gift-feast; the liberality is, of course, shown in its distribution; and the forethought is displayed in selecting as the special objects of this liberality those who are most likely to be able to return it. By a well-understood rule, which among these punctilious natives had all the force of a law of honor, every recipient of a gift at a potlatch was bound to return its value, at some future day, twofold.

And in this repayment his relatives were expected to aid him; they were deemed, in fact, his sureties. Thus a thrifty and aspiring burgher who, at one of these gift-feasts, had emptied all his chests of their accumulated stores, and had left himself and his family apparently destitute, could comfortably reflect, as he saw his visitors depart in their well-laden canoes, that he had not only greatly increased his reputation, but had at the same time invested all his means at high interest, on excellent security, and was now, in fact, one of the wealthiest as well as most esteemed members of the community.

An Overlooked Mode of Iceberg Formation.—To the familiar explanation of the formation of icebergs must be added another. Mr. Israel C. Russell, in recounting his expedition to Mount St. Elias, says that the foot of a glacier extends out under the muddy water, sometimes for a thousand feet or more, in front of the visible part of the ice-cliffs. When this extension of the ice-foot has reached the point where the buoyancy of the ice at the bottom exceeds its strength, huge pieces break off and rise to the surface. The sudden appearance of these masses of ice is always startling. "At first it seems," says Mr. Russell, "as if some huge sea-monster had risen from the deep and was lashing the waters into foam." Soon it can be seen that a blue island has appeared above the surface, carrying up hundreds of tons of water, which flows down its sides in cataracts of foam. The fragments which rise from the bottom in this manner are usually larger than those broken from the faces of the ice-cliffs, sometimes measuring two hundred or three hundred feet in diameter. Their size and the suddenness with which they rise would insure certain destruction of a vessel venturing too near the treacherous ice-walls.

Artificial Globular Lightning.—M. Planté has used his secondary batteries to reproduce on a small scale the phenomenon of globular lightning. M. von Lepel has shown that it can be obtained also by means of static electricity given by an induction machine. When two small copper wires from the poles of a strong machine are held at a certain distance from the opposite faces of a plate of mica, ebonite, or glass, small luminous red balls will be seen moving here and there, at times slowly, at others rapidly, and sometimes in a stationary position. The most remarkable effects are got with a plate of glass or disk of paper rubbed with paraffine. M. von Lepel believes that the vehicles of the luminous phenomena are small particles of liquid or dust. A slight current of air will remove the spherules, which will disappear faintly whistling. The experimenter remarks, further, that the phenomena are of weak tension. When this is increased, the luminous balls are no longer obtained, but instead of them the ordinary spark-discharge.

Contamination of Graveyard Soil.—As a part of the inquiry as to whether the soil of graveyards is liable to become infectious and dangerous, Dr. Justin Karlinski, of Konjica, Herzegovina, has undertaken to determine whether the organs of the body undergo any change in temperatnre during the natural process of decomposition after burial in the earth, and especially whether any difference appears in the case of infected subjects. His results show that the putrefactive process is invariably accompanied by a rise of temperature above that of the soil around, and that the rise is higher when the parts examined have been taken from bodies that have succumbed to infectious diseases than from other bodies. He found that typhoid bacilli may retain their vitality in the decomposing spleen for three months, and are annihilated only by rapid putrefaction. The author says that he had previously shown that typhoid bacilli could retain their vitality for five months in soil, but that if the earth were thoroughly saturated with rain-water they are destroyed in from seven to fourteen days. The part played by the soil in the origin of epidemics should not, he thinks, be underestimated, since typhoid bacilli can exist in water only for a comparatively short time.

Melanesian Ghosts.—According to Dr. R. H. Codington, in his studies of their Anthropology and Folk Lore, the Melanesians have no conception of the devil as an evil spirit, but are possessed by the belief in a

supernatural power or influence called *mana*, which shows itself in physical force, or in any kind of excellence which a man may possess. "This *mana* is not fixed in anything, and can be conveyed in almost everything; but spirits, whether disembodied souls or supernatural beings, have it and can impart it; and it essentially belongs to personal beings to originate it, though it may act through the medium of water or a stone or a bone. All Melanesian religion consists, in fact, in getting this *mana* for one's self, or getting it used for one's benefit—all religion, that is, as far as religious practices go, prayers and sacrifices." The sacrifices are different in different places. In the western islands the offerings are made to ghosts, and are consumed by fire as well as eaten; in the eastern islands they are made to spirits, and there is no sacrificial fire or meal. In the former, nothing is offered but food; in the latter money has a conspicuous place. Notwithstanding our association of idolatry with these people, Dr. Codington gives it no place in his account of their religion. Their belief is all in ghosts. There are land-ghosts and sea-ghosts, of which the latter have the more important place. At Wango, in the Solomon Islands, there was a canoe-house full of carvings and paintings representing native life, among them a canoe attacked by ghosts that haunt the seas. Two of them are composed as much as possible of forms of fishes—their spears and arrows long-bodied gar-fish and flying-fish. Even sharks have ghosts. In the volcanic islands it is generally believed that the souls of the dead ascend the mountain and are received within the craters by the ghosts which assemble to welcome the new-comer.

The "Rare Earths" in America.—Mr. Waldron Shapleigh exhibited at a recent meeting of the Franklin Institute some forty specimens of salts of what are called the rare earths, with minerals from which they are obtained, viz.: samarskite, zircon crystals, and monazite sand from North Carolina, monazite sand from Brazil, gadolinite from Texas, and allanite from Virginia. This was the first time the salts of praseodymium and neodymium have been shown and probably separated in this country; the separation of these elements is long and tedious. The specimens shown had undergone nearly 400 fractional distillations, and had been in a state of constant preparation since early in 1888. Tons of cerite and monazite sand had been used, and tons of the salts of cerium and lanthanum obtained, but the yield of praseodymium was only a few kilogrammes. The percentage of neodymium was much higher. Zirconium, lanthanum, and cerium should no longer be classed among rare earths, as hundreds of tons of ores from which they are obtained have been located in North Carolina, and there seems no end to the deposits of monazite sand, one of the richest ores, and containing most of the rare earths. In Brazil it does not have to be mined, as it is in the form of river-sand. In North Carolina it is found in washing for gold. Should the arts, trades, or manufactures create a demand for these so-called rare earths, Nature could readily supply it from these two localities. Thorium and yttrium minerals are not so easy to obtain, but they have recently been found in quantity in North Carolina and Texas.

Cultivation of the Poppy.—The poppy is cultivated for opium in a region of India about six hundred miles long and two hundred miles wide. The plants come into full flower in February, when they are some three or four feet high. Each stem produces from two to five capsules, about the size of a duck's egg. Previous to piercing these capsules, the petals of the flower, now beginning to fall off, are carefully collected. They are formed into circular cakes from ten to fourteen inches in diameter, and put into shallow earthen vessels which are heated over a slow fire, and are eventually used as shells or coverings for the drug. When the capsules have reached their highest development, the ryot visits his poppy-field in the afternoon and scarifies each capsule from top to bottom, adding sometimes a horizontal cutting. The juice at once begins to exude; milky white at first, but afterward taking on a pinkish tinge. The exudation continues during the night. If there is no wind and abundance of dew, the return is favorable. A westerly wind and cloudy atmosphere diminish the yield.

At an early hour the next morning the ryot again repairs to the field and collects the thickened juice from the capsules. The juice is next emptied into an earthenware pot, and the ryot is expected to expose it every day to the air, but not to the sun; to turn over the mass daily, so as to insure its being thoroughly dried; to keep it free from impurities or adulterations; and to bring it up to the highest standard of consistence and strength. When he has persevered with this process for three weeks or a month he delivers the raw opium at the factory. A dark, coffee-colored fluid, called *pussana*, exudes from the juice when it is fresh, which contains many of the active principles of the drug, and is dealt with separately. Besides the collected petals which form the envelope of the drug, and the *pussana*, the ryot has other sources of profit in the poppy. The stems and leaves of the plant are left till they become thoroughly dried up under the hot winds of April and May. They are then removed, broken up into a coarse powder, and used for the packing of the cakes. The oil is used for cooking and lighting. The seeds are like caraway and are sold as comfits; and after the extraction of the oil a dry cake remains, which is given to cattle or sold for medicinal purposes.

Time-reckoning on the Congo.—According to an account of the geography and meteorology of the natives of the cataract region of the Congo, given in the *Mouvement géographique*, the day is the solar day, in the length of which no variation (the range being only about forty minutes) is recognized. It is divided into four parts of three hours each, which are indicated by stretching the arm or pointing to the east for sunrise; 45° toward the east for nine o'clock; toward the zenith for noon; 45° toward the west for three o'clock, and horizontally toward the west for sunset. Each hour has its name, that for sunrise meaning "early," and that for sunset, "the sun is dead." If a native is asked how long it will take to go to a certain village, he will answer by pointing to where the sun stands at starting, and toward where it will be when the point is reached. Thus he indicates the number of hours by the astronomical angle corresponding with them. Four days form a week, and each day has its name. Public markets are distinguished by the name of the day on which they are held, and of the chief, village, or group of villages that control them. Seven four-day weeks form a month, which corresponds with the lunar month. Long durations of time are expressed in moons; the black does not take account of years. Although he distinguishes the seasons and recognizes their periodicity, he has no fixed point by which to determine the revolution of the sun. The five seasons of the Congo are that of abundant and continuous rains (from the middle of February to the middle of May); that of the end of the great rains and the beginning of the dry season, when the grass grows high (middle of May to middle of July); the dry season, continuing till the middle of September—also the season of great hunts; the beginning of the lesser rainy season, when the sapotas begin to grow (middle of September till the end of November); and the season of decreasing rains, or lesser dry season, when the sapotas are eatable (December, January, and early February). The phases of the moon are understood. The new moon is called the child moon, and the moon at its last quarter the dead moon. The blacks know that the new moon is the same that appeared in the preceding month, but they have no explanation for the phenomenon. They have no notion concerning the stars, further than to recognize the brightness of Venus and give it a name, and to name the constellation of the Three Kings. Atmospheric phenomena — rains, droughts, thunder, rainbows, halos, etc.—are attributed to the action of the spirits invoked by the fetich-priests.

Evolution on the Railroad.—It is most interesting, says Mr. W. Armstrong Willis in the Gentleman's Magazine, to trace how tenaciously the first railway managers in England clung to the traditions of coaching. The builders of the first railway carriages made no allowance for the changed mode of progression and motion which was introduced with the steam-engine. They retained the short, narrow, stuffy body of the stage-coach, set it upon four wheels of another make, and then attached it to the engine as to a new, enlarged kind of horse. With the increased

speed of traveling the motion became intolerable, and, when a high rate of speed was reached, few people could keep their seats. By degrees, but very slowly, these things were improved. Better ventilation was insured, more wheels were added, and the carriages were enlarged; doors and windows were so constructed as to keep out the clouds of dust that choked the traveler on badly made and ill-kept lines. The same principle of evolution which has turned the old stage-coach into the comfortable saloon-carriage has been at work in every department of railways and their management, and the highly intricate and important system of modern signaling springs from a most simple beginning. Shortly after the opening of the Stockton and Darlington line, which was the earliest line constructed, one of the station-masters is traditionally said to have adopted the simple expedient of putting a lighted candle in the window of the station-house when it was necessary for the train to stop. When the Liverpool and Manchester Railway was first opened, in 1830, the only means of signaling the trains was a flag by day and a lamp by night. The first advance to modern signaling began about four years after the line had been opened, when stout posts were provided upon which lamps were placed by the pointsman. Nowadays the signalman's cabin is the center from which all signaling radiates.

Rainfall by Explosion.—Reviewing the theories of artificial rain-making, Prof. E. J. Houston draws the general conclusions, in view of the present state of meteorological science, that rain can never be made to fall at will by mid-air explosions on any part of the earth's surface, irrespective of the climatic conditions there existing; but during certain meteorological conditions, mid-air explosions may result in rainfall over extended areas; that the liberation of energy necessary for such rainfalls is due not to the mid-air explosions, but to the energy stored up in the moist air from which the rain is derived; that the meteorological conditions which must exist for the successful action of mid-air explosions would probably in most though not in all cases themselves result in a natural production of rain; that a comparatively high difference of electric potential between different parts of the air, or between the air and the earth, is possibly favorable, when taken in connection with other meteorological conditions, for artificial rain-making; and that an undirected mid-air explosion is not as likely to produce rain as an explosion in which the main tendency of the energy liberated is to cause a general uprush of the air. Among the "certain meteorological conditions" mentioned in this summary is that in which the air is in a state of very unstable equilibrium, when a slight determining cause may result in the liberation of the stored-up energy, with a resulting heavy rainfall. In such cases it may appear that there are no reasons why an explosion in mid-air should not be followed by rain. In this case rain might be eventually caused without artificial aid. A condition in which heavy rains might be artificially produced by mid-air disturbances, when without them there would be none, may exist when a layer of warm, moist air exists between the earth's surface and a higher layer of cold, moist air, separated by a comparatively thin layer of air, and other conditions are such as to maintain the two layers separate. The breaking or piercing of the intermediate separating layer might then permit such an uprush of the warmer air as would result in the formation of a true storm center and a heavy rainfall.

Weddings among the Shushwap Indians.—Dr. Franz Boaz, in his report to the Hon. Horatio Hale for the British Association concerning the northwestern Indian tribes of Canada, describes from native accounts the marriage ceremonies of the Shushwap as follows: "A young man who wishes to marry a girl takes a number of horses and other property that is considered valuable, and offers it to the father of the girl he wishes to marry. The latter, before accepting the price offered, invites his whole family to a council and asks their consent. If they agree to accept the suitor, and the price he has offered for the girl is satisfactory, they tie the horses to their stable and take the other goods into the house, as a sign of their willingness. After this the young man may take the girl without further ceremonies. After the marriage the bridegroom and his family go on a hunting expedition, and try to obtain

as much game as possible, which is to be given to his father-in-law. The latter dresses the meat and invites the whole tribe to a feast. Then he and his family in their turn go hunting, and present the game they have obtained to the young man's father, who gives a feast to the whole tribe. At this time the girl's father returns all the payments he has received to the young man's father. For a number of days the couple live with the girl's family. When the young man goes to reside with his wife he asks all his friends to support him, and they give him presents of food and clothing. The latter he puts on, one suit on top of the other, goes to his father-in-law, and gives him all the property he carries. The latter distributes this property among the whole tribe according to the contributions every one has made. Then the young couple remove to the young man's family; and before leaving her father's house the bride is fitted out with presents in the same way as the young man was when he came to reside with her family. This is a present to the young man's father, who also distributes it among the tribe."

Some Characteristics of Waves.—The friction of the wind upon the sea-surface, the convulsions of deep-seated earthquakes, and the attraction of the heavenly bodies, give rise to three different kinds of sea-waves. If the wind blows directly parallel to the sea-surface, says a writer in Chambers's Journal, the friction may cause an ocean-current without wave-disturbance. As a rule the direction of the wind is inclined to the sea-surface, and its immediate effect is to produce a depression, which relieves itself by means of a wave to leeward and another to windward. This latter elevation is opposed by the wind, and gradually dies away, while the leeward wave is correspondingly accelerated. Each undulation shelters the water under its lee from the wind, which consequently impinges upon the sea a little in advance of the newly formed wave; and thus we get a series of parallel ridges and hollows, provided the wind remain steady in direction and intensity. There is no necessary connection between the advance of a wave and the forward movement of the water composing it, as may be seen by running the fingers along the keys of a piano. An inverted wave travels along, but the keys merely move up and down. Similarly, a wave may often be observed running along the ripe ears of golden grain while the stalks are firmly rooted in the soil. The onward progress of a sea-wave is easily perceptible, and by watching some light substance floating on the surface the fact is revealed that the water is not moving with the same velocity as the advancing wave. Should the wind direction suddenly change, a new series of waves will be generated, and cross-seas soon confront the mariner. Hence it is that in a cyclone, or revolving storm, where the wind is frequently changing, there are high waves rolling along from various directions, each as distinct as the ripples in a river, which cross one another without swerving from their course. Waves become short and abrupt in shallow water, and are far more dangerous to shipping than the long, regular billows of the ocean. It is probable that the greatest slope of a wave in open waters does not exceed thirty degrees, and frequently not more than fifteen degrees. Waves raised by the friction of the wind upon the water are relatively superficial. In heavy gales, however, lower depths become troubled, and the undulations more and more imposing. Occasionally an exceptionally large solitary wave is met with, advancing in awe-inspiring grandeur, its white crest towering high above all its fellows. Such ocean giants may be due to the fact that the elevations of series of waves having different lengths happen to coincide; or may be caused by squalls of wind, which are sometimes as terrible in intensity as they are sudden in formation.

The Wagging of the Dog's Tail.—Prof. Eimer, in his work on Organic Evolution, is not able to explain why the dogs of Constantinople erect the tail and carry it upright, while the ancestral wolf and the jackal carry it hanging down. Dr. Joseph L. Hancock suggests, in the American Naturalist, that the reason may be found in the fact that as the dog becomes domesticated it is prone to use the tail as an organ for expressing mental states—wagging it when pleased, dropping it between the legs when disappointed or frightened. The ancestral wolf

carries it hanging down, because in that position it is less conspicuous and better eludes detection. A family of wolves playing together undisturbed occasionally carry their tails curled upward. By degrees the tail acquires naturally the upright position as a result of coincident evolution of the mind of the wolf by domestication and of the slow adaptation of the appendage as an organ of expression. The cessation of natural selection in the domestic dog would give the tail greater freedom of motion without detriment to life; and artificial selection modifies it into various shapes.

Sulphur in Sicily.—According to the report of the United States consul at Palermo, there are now about three hundred sulphur mines in Sicily. The deposits are estimated to amount to about 30,000,000 tons, and the annual production to 400,000 tons. The royalties vary from twelve to forty-five per cent, according to the quality of the ore and the facilities for producing the sulphur, and average about twenty-five per cent. The external indications of the presence of sulphur are the appearance of gypsum and sulphurous springs. When the miners detach the ore from the surrounding material, vast cavities are often left which have to be supported on pillars of rock, and frequently give way with disastrous results. Seven different qualities are recognized, and determined by color. The mines have declined in prosperity since the extraction of sulphur from iron pyrites has come into use, and two thirds of them are represented to be at the point of suspension.

Cause of Chinese Emigration. — The main cause of the emigration from China, which is filling all other countries with apprehension, is traced by a Dutch colonial officer in the East Indies, not to the excess of population, but to the poverty of the soil in the provinces whence the emigrants come. The mass of the emigration is from the bare mountainous valleys of the eastern part of China, where the soil yields but little and the rainfall is slight. Disafforestation, making wood scarce and dear, is another factor in the matter. The author believes that as soon as China earnestly sets itself to the task of constructing railways and other great works the stream of emigration will be stopped; for the people will find in the interior of their own country the work and means of livelihood which they now seek for elsewhere.

University-extension Lectures on Science. —Arrangements have been made, in connection with the English university-extension movement, for one month's residence during the long vacation of extension students within the university precincts, where lectures will be given them on the subjects of their studies. The lectures for 1891 included a discussion of the criticism of Weismann's theory of heredity, by Mr. Poulton; the functions of the heart, by Mr. Gotch; the benzene ring, by Prof. Odling; a course of practical chemistry, under the supervision of Mr. Marsh; practical instruction in geology, by Prof. Green and Mr. Badger, with excursions; practical astronomy; four lectures on the application of science to the art of agriculture; the management of poultry; and manures.

NOTES.

A PRACTICAL paper on Some Means of Health in School-houses is contributed to the 1890 Report of the Wisconsin Board of Health by Hon. W. D. Parker. One of the arrangements that Mr. Parker strongly commends is the "dry-air closet," so called because a current of dry air, coming from the ventilating flues of the building, is passed through the vault and carries off all the moisture from it, leaving only a small quantity of dry, inoffensive solid matter, which can be shoveled out. This result, he says, is almost incredible, but has been established by sufficient tests.

THE fact that the science relating to electricity has no name of its own is noted by the editor of Our Language, who proposes that it be called "electrics." The pair of words, "electrics" and electrician, would be in analogy with optics and optician, mechanics and mechanician, mathematics and mathematician, and many others. At present the word electricity performs two functions similar to those which are separated in the case of light and optics, heat and thermotics, sound and acoustics.

AN instance of a spider catching a small mouse, very similar to one published in the Monthly for May, 1890, comes to us from Columbus, Ohio. The mouse was found by Mr. W. J. Dawson suspended by a cable

of spider's threads under a counter in his grocery-store, 511 West Broad Street. It had been hoisted three inches from the floor, and the spider, which was no bigger than the end of a lead-pencil, was by dint of hard work very slowly hauling it up further, the captive being alive and struggling. After about an hour the cord was broken and the mouse was carried away and killed.

M. MAXIM, the inventor of the Maxim gun, is studying the construction of directable flying-machines, and believes that he has obtained a motor of sufficient force. M. Fontes Pereira de Mello believes that he is on the right road to the invention of a practical submarine boat.

THE primitive monuments of the Baleric Islands are described by M. Cartailhac as of a Cyclopean or Pelasgic character, similar to those which are found throughout the Mediterranean region. Remains of real fortified towns, like a Greek acropolis, exist in Majorca and Minorca, usually at some distance from the most exposed coasts, sometimes on a plain and sometimes on an elevated spot. In the inside of each town there was a special monument of large hewn stones, so arranged as to form a semicircle. There were also galleries constructed by placing stones on pillars, under which one could hardly stand upright; and towers called *talayots*, the huge walls of which concealed small crypts or cellars. Human bones were found interred in artificial grottoes or crypts, to each of which entrance was gained by a small antechamber leading by a narrower portal.

THE Illinois Experiment Station reports the results of comparative experiments at four stations—three of them in light-colored soils and the other in a darker soil—in raising wheat: on unmanured ground, on ground heavily treated with barn-yard manure, five wagon-loads to the quarter-acre, and on ground treated with one hundred pounds of superphosphate to the quarter-acre. The results showed decisively the superiority of the barn-yard manuring, while the beneficial effects of superphosphates on the amount of yield were relatively small.

ONE of the remarkable results of the spectroscopic observation of the great nebula of Orion by Mr. Keeler at Lick Observatory is the representation in them of the direction of the earth's orbital motion, so that the observer "would with some confidence undertake to determine the month of the year by measuring the distance of the principal line from the lead line used in the spectrum."

To estimate the relative merits of different kinds of points for lightning-conductors, Dr. Hess recently collected and examined nineteen heads of conductors that had been struck by lightning. His conclusions are that the fusion of points of lightning-conductors by lightning causes no danger of fire through scattering of fused drops, for this does not occur; that fine and smooth points receive the lightning-stroke in concentrated form, while sharply angled and ribbed and blunt points divide it into threads; that platinum needles and tips have no advantage over copper points; and that there are lightning-strokes which are capable of making incandescent brass wire 7·2 millimetres (say 0·29 inch) thick. Unbranched copper conductors should therefore never be thinner than 7 millimetres.

ACCORDING to the observations of M. A. Muntz, the rain-water and the herbage of elevated regions are much poorer in sodium chloride than those of the lowlands, and the milk and the blood of animals feeding on the mountains contain a decidedly less proportion of the salt than are found in similar animals from the plains.

OBITUARY NOTES.

MR. CHARLES SMITH WILSON, Government Geologist of New South Wales, died August 26th, in his forty-eighth year. He was an original member of the Linnæan Society of New South Wales, and its president in 1883 and 1884.

MR. WILLIAM B. WATSON, who died at Bolton, England, October 6th, in his eightieth year, was one of Dalton's last surviving pupils, and assisted him in his researches on the composition of the atmosphere, and was one of his nurses in his illness.

THE REV. PERCY W. MYLES, an English botanist and editor of Nature Notes, the journal of the Selborne Society, died October 7th, in his forty-third year. He was author of the Pronouncing Dictionary of Botanical Names appended to Nicholson's Dictionary of Gardening, which is recognized as a standard. As his circumstances were narrow, a Myles memorial fund is proposed to be raised for the benefit of his widow, for which Prof. George Henslow will receive contributions.

THE death of Mr. Thomas Wharton Jones, F. R. S., one of Prof. Huxley's teachers forty years ago, is announced. He was nearly eighty years of age.

DR. PHILIP HERBERT CARPENTER, fourth son of the late Dr. W. B. Carpenter, died at Eton College, England, October 21st, in his fortieth year, from the administration of chloroform during temporary insanity. He had been connected, in a scientific capacity, with expeditions of the Lightning and Porcupine, and with the Valorous of Sir G. Nares's Arctic Expedition. He made a specialty of the study of echinoderms, in which he became distinguished as an authority, and on which he published several papers and reports.